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**RESULTS OF THE JULY 23, 2013
RELATIVE ACCURACY TEST AUDIT OF
THE CO/SO₂/NO_x/CO₂/FLOW CEM SYSTEM INSTALLED
ON THE S20 STACK AT THE MANITOWOC PUBLIC
UTILITIES FACILITY IN MANITOWOC, WISCONSIN**

Submitted to:

Mechanical Systems Inc.
480 Progress Way
Sun Prairie, WI 53590

Attention:

Rocky Orzechowski

Reviewed by:



Kathleen Eickstadt
Coordinator
Source Testing

Report Number 13-32333 (S20)
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DVH

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ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	dry standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	Diameter
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/ 10^6 BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/dscm	milligrams per dry standard cubic meter
ug/dscm	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
ug	micrograms
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure

1 INTRODUCTION

On July 23, 2013, Interpoll Laboratories personnel conducted a Title 40, Part 75, CO/SO₂/NO_x/CO₂ and Flow Relative Accuracy Test Audit of the CEM System installed on the S20 Stack at the Manitowoc Public Utilities Facility in Manitowoc, Wisconsin. The following CEMs were tested:

Monitor

Type	Manufacturer	Model	Serial No.	Location
NO _x	TECO	42i-d	0908635558	S20 Stack
SO ₂	TECO	43i	0908635559	S20 Stack
CO ₂	TECO	41i	0811429266	S20 Stack
CO	TECO	48i	08270019	S20 Stack
Flow	United Sciences	150	1500877	S20 Stack

On-site testing was performed by Aaron Wilson and Nate Beinemann. Jim Fanning of Mechanical Systems, Inc. and Tim Harding of Manitowoc Public Utilities provided coordination between testing activities and plant operation. A representative of the Wisconsin DNR did not witness testing.

Carbon Monoxide, Sulfur Dioxide, Oxides of Nitrogen, and Carbon Dioxide evaluations were performed in accordance with EPA Methods 10, 3A, 6C, and 7E CFR Title 40, Part 60, Appendix A and Part 75. For oxygen analysis, a slipstream of sample gas was withdrawn from the exhaust gas stream using test ports (provided by the plant) on the stack adjacent to the CEMS using a heat-traced probe and filter assembly. After passing through the filter, the gas passed through two condenser-type moisture removal systems operating in series. The particulate-free dry gas was then transported to the oxygen analyzer with the excess exhausted to the atmosphere through a calibrated orifice, which was used to ensure that the flow from the stack exceeds the requirements of the analyzer. For SO₂, NO_x, CO and CO₂ analysis, a dilution probe based system was used. In this system a slipstream of exhaust gas is drawn from the exhaust gas stream using an M&C dilution probe. The sample stream is filtered and diluted (approximate dilution during these tests was 100:1) before delivery to the SO₂, NO_x, CO and CO₂ analyzers.

The test runs were performed by moving the sample probe through a three-point traverse (1/6, 3/6, 5/6 of the duct depth). The instruments were calibrated before and after the runs as per EPA Methods 3A,

6C, and 7E using EPA Protocol 1 gases.

The reference method CO₂, SO₂, CO and NO_x concentrations were recorded using a computer datalogger. Copies of the computer printouts are included in this report.

Moisture determinations were performed psychometrically. Volumetric flow rate determinations were determined with a Type S pitot tube using EPA Method 2 and applying the default wall adjustment factor of 0.9900 for a brick lined stack according to Method 2H, section 2.2.2. Flow measurements were conducted from four test ports oriented at ninety degrees on the stack using a 16-point traverse. The flow rate monitor was certified at low and mid load conditions.

The results of the CEM Relative Accuracy Test Audit are summarized in Section 2. Field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The results of the Relative Accuracy Test Audit are summarized in the following tables. An overview of the results is presented below:

S20 STACK RELATIVE ACCURACY RESULTS

Parameter	Units	Measured
NO _x	LB/10 ⁶ BTU	2.61
NO _x	ppm,w	2.98
SO ₂	ppm,w	5.11
SO ₂	LB/10 ⁶ BTU	6.37
CO ₂	% v/v,w	1.86
CO	ppm,w	2.23
CO	LB/10 ⁶ BTU	3.53
Flow (LOW)	SCFH	3.12
Flow (HIGH)	SCFH	4.29

No difficulties were encountered in the field or in the evaluation of the data. On the basis of these facts and a complete review of the data and results, it is our opinion that the CO₂, SO₂ and NO_x concentrations reported herein are accurate and closely reflect the actual values, which existed at the time the test was performed.

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
of the NOx Analyzer Installed on the S20 Boiler Stack at the
Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 KIbs/Hr)

Run	Date	Time	Nox Lbs/mmBTU		
			RM	CEM	DIFF.
1	07/23/13	14:50 - 15:10	0.100	0.098	0.002
2	07/23/13	15:20 - 15:40	0.098	0.097	0.001
3	07/23/13	15:50 - 16:10	0.090	0.091	-0.001
4	07/23/13	16:20 - 16:40	0.088	0.090	-0.002
5	07/23/13	16:50 - 17:10	0.087	0.089	-0.002
6	*	17:20 - 17:40	0.085	0.088	-0.003
7	07/23/13	17:50 - 18:10	0.085	0.087	-0.002
8	07/23/13	18:20 - 18:40	0.087	0.088	-0.001
9	07/23/13	18:50 - 19:10	0.088	0.090	-0.002
10	07/23/13	19:20 - 19:40	0.088	0.091	-0.003
Average Diff.			0.090	0.091	-0.001111
Standard Deviation					0.002
Confidence Coefficient					0.001242
Relative Accuracy					2.61
Bias Test					Pass
Bias Adjustment Factor					0.988
* Run was not used in Relative Accuracy calculation					
RM = Reference Method					
CEM = Continuous Emission Monitor					

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
of the NOx Analyzer Installed on the S20 Boiler Stack at the
Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 Klbs/Hr)

Run	Date	Time	Nox ppm, wet		
			RM	CEM	DIFF.
1	07/23/13	14:50 - 15:10	21.7	22.0	-0.3
2	07/23/13	15:20 - 15:40	21.2	21.7	-0.5
3	07/23/13	15:50 - 16:10	20.2	20.7	-0.5
4	07/23/13	16:20 - 16:40	19.9	20.5	-0.6
5	07/23/13	16:50 - 17:10	19.6	20.3	-0.7
6	*	17:20 - 17:40	19.6	20.3	-0.7
7	07/23/13	17:50 - 18:10	19.6	20.2	-0.6
8	07/23/13	18:20 - 18:40	19.9	20.4	-0.5
9	07/23/13	18:50 - 19:10	20.3	20.8	-0.5
10	07/23/13	19:20 - 19:40	20.4	20.9	-0.5
Average Diff.			20.311	20.833	-0.522
Standard Deviation					0.109
Confidence Coefficient					0.084008
Relative Accuracy					2.98
Bias Test					Pass
Bias Adjustment Factor					0.975

* Run was not used in Relative Accuracy calculation

RM = Reference Method

CEM = Continuous Emission Monitor

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
 of the SO₂ Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 KIbs/Hr)

Run	Date	Time	SO₂ ppm, wet		
			RM	CEM	DIFF.
1	07/23/13	14:50 - 15:10	43.7	42.2	1.5
2	*	07/23/13 15:20 - 15:40	42.2	38.2	4.0
3	07/23/13	15:50 - 16:10	44.1	41.1	3.0
4	07/23/13	16:20 - 16:40	40.8	39.3	1.5
5	07/23/13	16:50 - 17:10	40.2	40.2	0.0
6	07/23/13	17:20 - 17:40	40.6	39.5	1.1
7	07/23/13	17:50 - 18:10	42.4	39.9	2.5
8	07/23/13	18:20 - 18:40	42.3	40.3	2.0
9	07/23/13	18:50 - 19:10	42.3	42.2	0.1
10	07/23/13	19:20 - 19:40	42.4	42.2	0.2
Average Diff.			42.089	40.767	1.322222
Standard Deviation					1.077
Confidence Coefficient					0.827681
Relative Accuracy					5.11
Bias Test					Fail
Bias Adjustment Factor					1.032
* Run was not used in Relative Accuracy calculation					
RM = Reference Method					
CEM = Continuous Emission Monitor					

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
 of the SO₂ Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 KIbs/Hr)

Run	Date	Time	SO ₂ Lbs/mmBTU		
			RM	CEM	DIFF.
1	07/23/13	14:50 - 15:10	0.280	0.262	0.018
2	*	07/23/13 15:20 - 15:40	0.270	0.239	0.031
3	07/23/13	15:50 - 16:10	0.274	0.252	0.022
4	07/23/13	16:20 - 16:40	0.249	0.241	0.008
5	07/23/13	16:50 - 17:10	0.249	0.246	0.003
6	07/23/13	17:20 - 17:40	0.244	0.239	0.005
7	07/23/13	17:50 - 18:10	0.256	0.239	0.017
8	07/23/13	18:20 - 18:40	0.258	0.242	0.016
9	07/23/13	18:50 - 19:10	0.256	0.253	0.003
10	07/23/13	19:20 - 19:40	0.254	0.254	0.000
Average Diff.			0.258	0.248	0.010222
Standard Deviation					0.008
Confidence Coefficient					0.006195
Relative Accuracy					6.37
Bias Test					Fail
Bias Adjustment Factor					1.041

* Run was not used in Relative Accuracy calculation

RM = Reference Method

CEM = Continuous Emission Monitor

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
 on the CO2 Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 KIbs/Hr)

CO₂, wet Summary								
Run	Date	Time		RM	CEM			
1	*	07/23/13	14:50	-	15:10	4.9	5.0	-0.1
2		07/23/13	15:20	-	15:40	4.9	5.0	-0.1
3		07/23/13	15:50	-	16:10	5.0	5.1	-0.1
4		07/23/13	16:20	-	16:40	5.1	5.1	0.0
5		07/23/13	16:50	-	17:10	5.0	5.1	-0.1
6		07/23/13	17:20	-	17:40	5.2	5.1	0.1
7		07/23/13	17:50	-	18:10	5.2	5.2	0.0
8		07/23/13	18:20	-	18:40	5.1	5.2	-0.1
9		07/23/13	18:50	-	19:10	5.2	5.2	0.0
10		07/23/13	19:20	-	19:40	5.2	5.2	0.0
Average Difference				5.088	5.125	-0.03750		
Standard Deviation						0.074		
Confidence Coefficient						0.057191		
Relative Accuracy						1.86		
Bias Test						Pass		
Bias Adjustment Factor						0.993		
* Run was not used in Relative Accuracy calculation								
RM = Reference Method								
CEM = Continuous Emission Monitor								

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
 of the CO Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 KIbs/Hr)

Run	Date	Time	CO ppm, wet		
			RM	CEM	DIFF.
1	07/23/13	14:50 - 15:10	38.7	39.1	-0.4
2	07/23/13	15:20 - 15:40	38.0	36.9	1.1
3	*	15:50 - 16:10	40.5	38.1	2.4
4	07/23/13	16:20 - 16:40	37.8	35.9	1.9
5	07/23/13	16:50 - 17:10	36.1	36.3	-0.2
6	07/23/13	17:20 - 17:40	36.4	37.5	-1.1
7	07/23/13	17:50 - 18:10	37.3	37.5	-0.2
8	07/23/13	18:20 - 18:40	36.4	36.4	0.0
9	07/23/13	18:50 - 19:10	35.8	35.7	0.1
10	07/23/13	19:20 - 19:40	36.8	36.6	0.2
Average Diff.			37.033	36.878	0.155556
Standard Deviation					0.873
Confidence Coefficient					0.671332
Relative Accuracy					2.23
Bias Test					Pass
Bias Adjustment Factor					1.004

* Run was not used in Relative Accuracy calculation

RM = Reference Method

CEM = Continuous Emission Monitor

Summary of the Results of the July 23,2013, Relative Accuracy Test Audit
 of the CO Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low "Normal" Load (80 KIbs/Hr)

Run	Date	Time	CO Lbs/mmBTU		
			RM	CEM	DIFF.
1	07/23/13	14:50 - 15:10	0.108	0.106	0.002
2	07/23/13	15:20 - 15:40	0.107	0.101	0.006
3	*	15:50 - 16:10	0.110	0.102	0.008
4	07/23/13	16:20 - 16:40	0.101	0.096	0.005
5	07/23/13	16:50 - 17:10	0.098	0.097	0.001
6	07/23/13	17:20 - 17:40	0.096	0.100	-0.004
7	07/23/13	17:50 - 18:10	0.098	0.099	-0.001
8	07/23/13	18:20 - 18:40	0.097	0.096	0.001
9	07/23/13	18:50 - 19:10	0.095	0.094	0.001
10	07/23/13	19:20 - 19:40	0.097	0.097	0.000
Average Diff.			0.100	0.098	0.001222
Standard Deviation					0.003
Confidence Coefficient					0.002299
Relative Accuracy					3.53
Bias Test					Pass
Bias Adjustment Factor					1.012
* Run was not used in Relative Accuracy calculation					
RM = Reference Method					
CEM = Continuous Emission Monitor					

Results of the July 23, 2013 Relative Accuracy Test Audit
 of the Flow Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

Low Load (80 KIbs/Hr)

Run	Date	Time		Flow (SCFH)		
				RM	CEM	DIFF.
1	07/23/13	5:15	-	3,743,000	3,560,000	183,000
2	07/23/13	6:20	-	3,720,000	3,580,000	140,000
3	*	6:31	-	3,723,000	3,495,000	228,000
4	07/23/13	6:39	-	3,537,000	3,640,000	-103,000
5	07/23/13	7:02	-	3,711,000	3,660,000	51,000
6	07/23/13	7:11	-	3,679,000	3,535,000	144,000
7	07/23/13	7:17	-	3,706,000	3,729,000	-23,000
8	07/23/13	7:42	-	3,600,000	3,678,000	-78,000
9	07/23/13	7:50	-	3,622,000	3,583,000	39,000
10	07/23/13	7:58	-	3,653,000	3,700,000	-47,000
Average Diff.				3663444.444	3629444.444	34000.000
Confidence Coefficient						80147.093371
Standard Deviation						104267.684
Relative Accuracy						3.12
Bias Test						Pass
Bias Adjustment Factor						1.009

* Run was not used in Relative Accuracy calculation

RM = Reference Method

CEM = Continuous Emission Monitor

Results of the July 23, 2012 Relative Accuracy Test Audit
 of the Flow Analyzer Installed on the S20 Boiler Stack at the
 Manitowoc Public Utilities Plant located in Manitowoc, Wisconsin.

High Load (190 KIbs/Hr)

Run	Date	Time		Flow (SCFH)		
				RM	CEM	DIFF.
1	07/23/13	10:40	-	4,724,000	4,889,000	-165,000
2	07/23/13	10:47	-	4,760,000	4,973,000	-213,000
3	07/23/13	10:54	-	4,775,000	4,916,000	-141,000
4	07/23/13	11:30	-	4,711,000	4,929,000	-218,000
5	07/23/13	11:37	-	4,819,000	4,950,000	-131,000
6	* 07/23/13	11:44	-	4,696,000	4,952,000	-256,000
7	07/23/13	11:51	-	4,815,000	4,935,000	-120,000
8	07/23/13	11:58	-	4,857,000	5,015,000	-158,000
9	07/23/13	12:05	-	4,830,000	4,938,000	-108,000
10	07/23/13	12:12	-	4,786,000	5,038,000	-252,000

Average Diff. 4786333.333 4953666.667 -167333.333

Confidence Coefficient 38132.374982

Standard Deviation 49608.467

Relative Accuracy 4.29

Bias Test Pass

Bias Adjustment Factor 0.966

* Run was not used in Relative Accuracy calculation

RM = Reference Method

CEM = Continuous Emission Monitor

APPENDIX A

SAMPLING TRAIN CALIBRATION DATA

INTERPOLL LABORATORIES, INC.
(763) 786-6020

Temperature Measurement Device Calibration Sheet

Unit under Test:

Vendor	Cen Tech	Serial Number	6048682
Model	92242	Thermocouple Type	Type K
Range	0-2000	Technician	Mike Bonham
Date of Calibration	8/2/2012	PDT Number	138

Method of Calibration:

Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is +/- 0.1 % of span(2100 oF) +/- 1 degree (for negative temperatures add +/- 2 degrees). The CL-300 simulated exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp. (°F) Nominal	Response of Unit Under Test (°F)	Deviation	
		Δt (°F)	%
0	9	9	1.919
100	103	3	0.533
200	210	10	1.493
300	304	4	0.524
400	405	5	0.578
500	501	1	0.104
600	605	5	0.469
700	700	0	0.000
800	804	4	0.316
900	901	1	0.073
1000	1006	6	0.409
1100	1103	3	0.192
1200	1204	4	0.240
1300	1301	1	0.057
1400	1404	4	0.215
1500	1503	3	0.153
1600	1604	4	0.194
1700	1700	0	0.000
1800	1800	0	0.000
1900	1901	1	0.042
2000	2000	0	0.000
2100			
Average:		3.24	0.3577

OF = off scale response by unit under test (oF)

% dev = $100\Delta t/(460+t)$

Unit was in tolerance

Unit was not in tolerance : Recalibrated see new calibration sheet or

(Must be within +/- 1.5% absolute reference temperature)

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Temperature Measurement Device Calibration Sheet

Unit under Test:

Vendor	Omega	Serial Number	201108
Model	hh-81	Thermocouple Type	Type K
Range	0-2100 °F	Technician	D Van Hoever
Date of Calibration	4/5/2013	PDT Number	85

Method of Calibration:

Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is +/- 0.1 % of span(2100 °F) +/- 1 degree (for negative temperatures add +/- 2 degrees). The CL-300 simulated exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp. (°F) Nominal	Response of Unit Under Test (°F)	Deviation	
		Δt (°F)	%
0	1	1	0.217
100	101	1	0.179
200	204	4	0.606
300	303	3	0.395
400	401	1	0.116
500	500	0	0.000
600	603	3	0.283
700	700	0	0.000
800	803	3	0.238
900	902	2	0.147
1000	1004	4	0.274
1100	1104	4	0.256
1200	1204	4	0.241
1300	1305	5	0.284
1400	1404	4	0.215
1500	1505	5	0.255
1600	1605	5	0.243
1700	1703	3	0.139
1800	1802	2	0.088
1900	1903	3	0.127
2000			
2100	OF		
	Average:	3	0.215

OF = off scale response by unit under test (oF)

% dev = $100|\Delta t|/(460+|t|)$

Unit was in tolerance

Unit was not in tolerance : Recalibrated see new calibration sheet or
(Must be within +/- 1.5% absolute reference temperature)

INTERPOLL LABORATORIES, INC.
(763) 786-6020

Stack Sampling Department - QA
Field Barometer Calibration Sheet

Date:	4/5/2013
Technician:	Aaron Wilson
Mercury Column Barometer Number:	Weighing Room Barometer
Aneroid Barometer Number:	NO.1 (2109004)

Reference Mercury Barometer Reading	Ambient Temperature	Temperature Correction Factor	Adjusted Mercury Barometer Reading	Initial Field Barometer Reading	Difference ($P_{ba} - P_{bm}$)
29.27	76	0.124	29.15	29.13	-0.016

Weighing room barometer setup:

- 1) Using the set screw on the bottom of the barometer, adjust the level of the mercury reservoir to the point that the level indicator makes slight contact with the mercury. A flashlight can aid in seeing the dimple formed when the level indicator makes contact with the mercury.
- 2) Slide the measurement ruler on the barometer to the point where the bottom of the ruler is in line with the top of the mercury column's reverse meniscus. Record the reading (in. Hg)
- 3) Take a temperature reading and record the temperature correction factor from the lookup table near the barometer.
- 4) Apply the temperature correction factor to the mercury barometer.
- 5) Adjust the field barometer reading to within +/- 0.1 in. Hg of the reference barometer reading.

Has this barometer shown any consistent problems with calibration? Has the problem been alleviated?

Note: Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20 - 30 minutes before calibrating. Aneroid barometer will be calibrated to the adjusted mercury barometer readings.

Alternative Calibration Procedure:

- 1) Obtain the station value or absolute barometric pressure P_r from a nearby National Weather Service station and its elevation (A) in feet above sea level.
- 2) Determine the elevation (B) in feet above sea level of the site of the field barometer.(local airport)
- 3) Calculate the site barometric pressure (P_b) as follows:

$$P_b = P_r + 0.001 (A-B)$$
- 4) Compare the field barometer reading against P_b obtained in step 3.
- 5) Adjust the field barometer reading to within +/- 0.1 in. Hg.



Environmental Supply Company, Inc.

Quality Source Sampling Systems & Accessories

Wind Tunnel Pitot Calibration

Customer: Interpolis Laboratories

S-type Pitot ID:	04-5+P1	Date:	1-Apr-13
Standard Pitot ID:	001	Personnel:	DH
Cp(std):	0.99	Cp(actual):	0.831
Part Number:		P(bar):	29.35
Test Velocity (fps):	30 - 60 - 90	T(°F):	56

Calibration Results				
Velocity (fps)	Nominal ΔPs [inches H ₂ O]	Cp _(s) A-Side	Cp _(s) B-Side	Cp _(s) Average
30	0.264	0.834	0.836	0.835
60	1.142	0.825	0.833	0.829
90	2.623	0.824	0.833	0.828
Overall Average				0.831

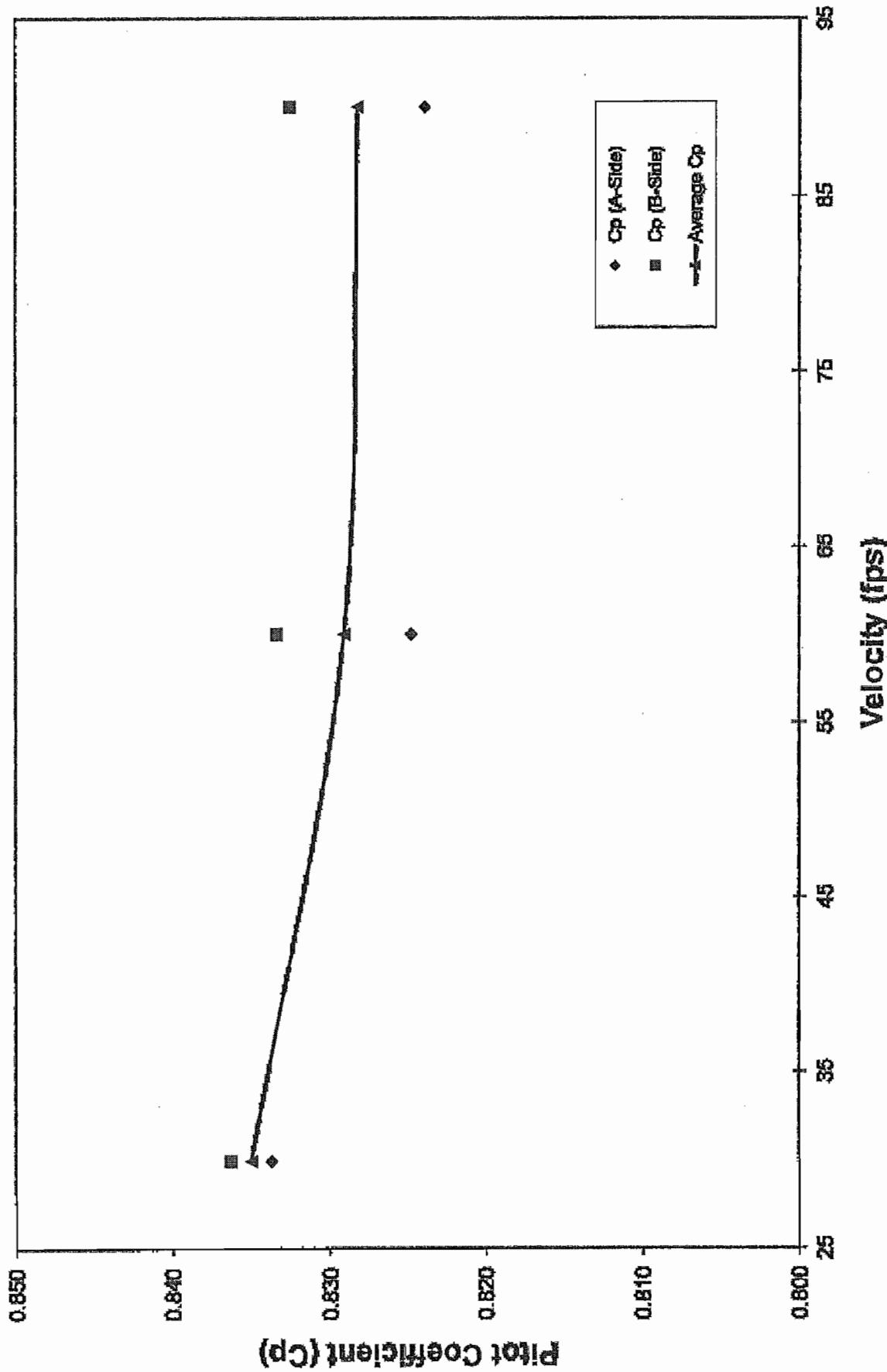
Pitot tube S/N 04-5+P1 was calibrated in accordance with the Code of Federal Regulations, Title 40, Part 60 Appendix A, Method 2, Section 10.

David H. Hunter
Signature

4/1/13
Date

S-Type Pitot (S/N 04-5+P1) - Pitot Coefficient (C_p) vs Velocity (fps)

Environmental Supply Company Wind Tunnel - 04/01/2013





Environmental Supply Company, Inc.



Wind Tunnel Pitot Calibration

S-type Pitot ID: **04-5+P1** Date: **1-Apr-13**
 Standard Pitot ID: **001** Personnel: **DH**
 Cp(std): **0.99** Cp(actual): **0.835**
 Part Number:
 Test Velocity (fps): **30** P(bar): **29.35**
 T(°F): **56**

W A-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.202	0.283	0.837	0.003
		0.202	0.285	0.834
		0.202	0.286	0.831
		0.201	0.285	0.833
		AVERAGE		0.834
		Std deviation		0.003

W B-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.202	0.282	0.839	0.003
		0.202	0.283	0.836
		0.202	0.284	0.835
		0.201	0.283	0.835
		AVERAGE		0.836
		Std deviation		0.002

$$Cp(s) = Cp(std) \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$Cp(A) - Cp(B) = [0.003] \text{ (must be } < 0.010\text{)}$$

$$\text{*Deviation} = \{Cp(s) - AVG Cp(s)\} \text{ (must be } < 0.010\text{)}$$

Standard deviation of the deviations must be less than 0.02 for both

Pitot tube S/N 04-5+P1 was calibrated in accordance with the CFR 40, Part 60 Appendix A, Method 2, Section 10.



Environmental Supply Company, Inc.

Quality Source Sampling Systems & Accessories

Wind Tunnel Pitot Calibration

S-type Pitot ID: **04-5+P1** Date: **1-Apr-13**
 Standard Pitot ID: **001** Personnel: **DH**
 Cp(std): **0.99** Cp(actual): **0.829**
 Part Number:
 Test Velocity (fps): **60** P(bar): **29.95**
 T(°F): **56**

A-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.799	1.154	0.824	-0.001
		0.803	1.153	0.827
		0.800	1.152	0.825
		0.802	1.159	0.824
		AVERAGE		0.825
		Std deviation		0.001

B-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.799	1.132	0.832	-0.002
		0.803	1.129	0.835
		0.800	1.130	0.833
		0.802	1.131	0.834
		AVERAGE		0.833
		Std deviation		0.001

$$Cp(s) = Cp(std) \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$Cp(A) - Cp(B) = \boxed{0.009} \quad \text{(must be <0.010)}$$

$$*Deviation = \{Cp(s) - AVG Cp(s)\} \quad \text{(must be <0.010)}$$

Standard deviation of the deviations must be less than 0.02 for both

Pitot tube S/N 04-5+P1 was calibrated in accordance with the CFR 40, Part 60 Appendix A, Method 2, Section 10.



Environmental Supply Company, Inc.



Wind Tunnel Pitot Calibration

S-type Pitot ID: 04-5+P1 Date: 1-Apr-13
Standard Pitot ID: 001 Personnel: DH
Cp(std): 0.99 Cp(actual): 0.828
Part Number: P(bar): 29.35
Test Velocity (fps): 90 T(°F): 56

A-SIDE	ΔP _{std} (in. H ₂ O)	ΔP _s (in. H ₂ O)	Cp(s)	Deviation*
	1.837	2.657	0.823	-0.001
	1.836	2.652	0.824	0.000
	1.832	2.642	0.824	0.001
	1.837	2.651	0.824	0.000
	AVERAGE		0.824	0.000
	Std deviation			0.001

B-SIDE	ΔP _{std} (in. H ₂ O)	ΔP _s (in. H ₂ O)	Cp(s)	Deviation*
	1.837	2.603	0.832	-0.001
	1.836	2.594	0.833	0.000
	1.832	2.588	0.833	0.000
	1.837	2.597	0.833	0.000
	AVERAGE		0.833	0.000
	Std deviation			0.001

$$Cp(s) = Cp(std) \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$Cp(A) - Cp(B) = 0.009 \quad \text{(must be <0.010)}$$

*Deviation = {Cp(s) - AVG Cp(s)} {must be <0.010}

Standard deviation of the deviations must be less than 0.02 for both.

Pitot tube S/N 04-5+P1 was calibrated in accordance with the CFR 40, Part 60 Appendix A, Method 2, Section 10.

APPENDIX B

REFERENCE METHOD COMPUTER PRINTOUTS

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 1
High Load (190 Klbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.033	0.182	240	10:40 AM
2	A-2	0.032	0.179	240	
3	A-3	0.034	0.184	240	
4	A-4	0.039	0.197	240	
5	B-1	0.037	0.192	241	
6	B-2	0.033	0.182	241	
7	B-3	0.032	0.179	241	
8	B-4	0.031	0.176	241	
9	C-1	0.035	0.187	243	
10	C-2	0.033	0.182	243	
11	C-3	0.031	0.176	243	
12	C-4	0.030	0.173	243	
13	D-1	0.036	0.190	240	
14	D-2	0.033	0.182	240	
15	D-3	0.030	0.173	240	
16	D-4	0.031	0.176	240	10:46 AM
Average		0.033	0.182	241	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	240	
Wet Bulb (°F)	113.0	Static Pressure
TRA	1.17	Pitot Coefficient
Vapor Pressure of Water	2.83	
ZT	127.00	Duct Width (in.)
PM	148.68	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	5.12	Stack Area (ft ²)
O ₂ %	12.043	Molecular Weight (dry)
CO ₂ %	7.45	Molecular Weight (wet)
Standard CFH	4,723,711	Stack Pressure
K Standard CFH	78.729	Feet per Second
		Actual CFM
		DSCFM
		107612.41
		74700.62

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	12.13	0.13	10.79	10.70	12.04 dry
CO ₂ (wet)	7.14	0.05	8.38	8.30	7.07 wet
Moisture	5.12				4,723,711
Fuel Factor C	1877				78.729
DSCFM	74701				

Results

Start Time	10:40 AM
Stop Time	10:46 AM
Standard CFH	4,724,000
CO ₂ %, wet	7.07
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 2
High Load (190 Kibs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.029	0.170	246	10:47 AM
2	A-2	0.033	0.182	246	
3	A-3	0.031	0.176	246	
4	A-4	0.034	0.184	246	
5	B-1	0.031	0.176	247	
6	B-2	0.032	0.179	247	
7	B-3	0.034	0.184	247	
8	B-4	0.033	0.182	247	
9	C-1	0.035	0.187	247	
10	C-2	0.034	0.184	247	
11	C-3	0.037	0.192	247	
12	C-4	0.038	0.195	247	
13	D-1	0.034	0.184	247	
14	D-2	0.035	0.187	247	
15	D-3	0.037	0.192	247	
16	D-4	0.036	0.190	247	10:53 AM
Average		0.034	0.184	247	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	246	
Wet Bulb (°F)	113.0	Static Pressure
TRA	1.17	Pitot Coefficient
Vapor Pressure of Water	2.83	
ZT	133.00	Duct Width (in.)
PM	142.33	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	4.90	168.00
O ₂ %	12.063	Stack Area (ft ²)
CO ₂ %	7.409	153.94
Standard CFH	4,760,486	Molecular Weight (dry)
K Standard CFH	79.341	29.668
		Molecular Weight (wet)
		29.097
		Stack Pressure
		29.061
		Feet per Second
		11.838
		Actual CFM
		109339.78
		DSCFM
		75455.51

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>	
O ₂ (dry)	12.13	0.10	10.77	10.70	12.06	dry
CO ₂ (wet)	7.14	0.06	8.40	8.30	7.05	wet
Moisture Fuel Factor C	4.90			Standard CFH	4,760,486	
DSCFM	1877			K Standard CFM	79.341	
	75456					

Results

Start Time	10:47 AM
Stop Time	10:53 AM
Standard CFH	4,760,000
CO ₂ %, wet	7.05
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 3
High Load (190 Kilbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points 16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.034	0.184	247	10:54 AM
2	A-2	0.038	0.195	247	
3	A-3	0.036	0.190	247	
4	A-4	0.032	0.179	247	
5	B-1	0.034	0.184	247	
6	B-2	0.035	0.187	247	
7	B-3	0.038	0.195	247	
8	B-4	0.031	0.176	247	
9	C-1	0.032	0.179	246	
10	C-2	0.034	0.184	246	
11	C-3	0.035	0.187	246	
12	C-4	0.036	0.190	246	
13	D-1	0.035	0.187	246	
14	D-2	0.031	0.176	246	
15	D-3	0.032	0.179	246	
16	D-4	0.033	0.182	246	11:00 AM
Average		0.034	0.185	247	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	247	
Wet Bulb (°F)	113.0	Static Pressure
TRA	1.17	Pitot Coefficient
Vapor Pressure of Water	2.83	
ZT	134.00	Duct Width (in.)
PM	141.28	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	4.86	Stack Area (ft ²)
O ₂ %	12.063	Molecular Weight (dry)
CO ₂ %	7.407	Molecular Weight (wet)
Standard CFH	4,774,655	Stack Pressure
K Standard CFH	79.578	Feet per Second
		Actual CFM
		DSCFM
		109629.19
		75708.88

Field Calculations

		<u>Raw Data Table</u>			<u>Gas Corrected for Calibration</u>
<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	
O ₂ (dry)	12.13	0.10	10.77	10.70	12.06 dry
CO ₂ (wet)	7.14	0.06	8.40	8.30	7.05 wet
Moisture	4.86				
Fuel Factor C	1877				
DSCFM	75709				
					4,774,655
					79.578

Results

Start Time	10:54 AM
Stop Time	11:00 AM
Standard CFH	4,775,000
CO ₂ %, wet	7.05
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 1-3

Time	%O₂, d	% CO₂, w
10:40	9.97	9.12
10:41	9.944	9.168
10:42	9.956	9.076
10:43	9.938	9.172
10:44	10.5	7.118
10:45	12.51	6.662
10:46	12.73	6.862
10:47	12.69	6.648
10:48	13.02	6.846
10:49	12.5	6.92
10:50	12.75	6.675
10:51	12.91	6.727
10:52	12.76	6.835
10:53	12.76	6.9
10:54	12.74	6.758
10:55	12.77	6.811
10:56	12.66	6.828
10:57	12.83	6.69
10:58	12.82	6.866
10:59	12.68	6.895
11:00	12.75	6.551
11:01	12.65	4.961

Average **12.129** **7.140**

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 4
High Load (190 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points 16

<u>Point Number</u>	<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.032	242	11:30 AM
2	A-2	0.033	242	
3	A-3	0.028	242	
4	A-4	0.030	242	
5	B-1	0.032	244	
6	B-2	0.034	244	
7	B-3	0.032	244	
8	B-4	0.035	244	
9	C-1	0.031	244	
10	C-2	0.033	244	
11	C-3	0.034	244	
12	C-4	0.035	244	
13	D-1	0.033	243	
14	D-2	0.034	243	
15	D-3	0.035	243	
16	D-4	0.036	243	11:36 AM
Average		0.033	0.181	243

Moisture Content Data

		<u>Flow Rate Data</u>	
Dry Bulb (°F)	242		
Wet Bulb (°F)	114.0	Static Pressure	-0.41
TRA	1.17	Pilot Coefficient	0.831
Vapor Pressure of Water	2.91		
ZT	128.00	Duct Width (in.)	0
PM	155.82	Duct Length (in.)	0
Barometric Pressure	29.09	Duct Area (ft ²)	0
Standard Meter Volume		Stack Diameter (in.)	168
Moisture Content	5.36	Stack Area (ft ²)	153.94
O ₂ %	12.928	Molecular Weight (dry)	29.608
CO ₂ %	6.818	Molecular Weight (wet)	28.986
Standard CFH	4,710,969	Stack Pressure	29.06
K Standard CFH	78.516	Feet per Second	11.658
		Actual CFM	107672.06
		DSCFM	74306.15

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	13.00	0.11	10.78	10.70	12.93 dry
CO ₂ (wet)	6.52	0.06	8.38	8.30	6.45 wet
Moisture	5.36				
Fuel Factor C	1877				
DSCFM	74306				
			Standard CFH	4,710,969	
			K Standard CFM	78.516	

Results

<u>Start Time</u>	11:30 AM
<u>Stop Time</u>	11:36 AM
<u>Standard CFH</u>	4,711,000
<u>CO₂ %, wet</u>	6.45
<u>WAF applied</u>	0.9900

MSI / Manitowoc PU
 Manitowoc, WI
 S20 Boiler Stack

7/23/2013
 Test 1H Run 5
 High Load (190 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.035	0.187	243	11:37 AM
2	A-2	0.033	0.182	243	
3	A-3	0.035	0.187	243	
4	A-4	0.032	0.179	243	
5	B-1	0.034	0.184	244	
6	B-2	0.038	0.195	244	
7	B-3	0.037	0.192	244	
8	B-4	0.035	0.187	244	
9	C-1	0.034	0.184	244	
10	C-2	0.035	0.187	244	
11	C-3	0.036	0.190	244	
12	C-4	0.034	0.184	244	
13	D-1	0.028	0.167	244	
14	D-2	0.034	0.184	244	
15	D-3	0.036	0.190	244	
16	D-4	0.036	0.190	244	11:43 AM
Average		0.035	0.186	244	
<u>Moisture Content Data</u>					
Dry Bulb (°F)		243			
Wet Bulb (°F)		114.0		Static Pressure	-0.39
TRA		1.17		Pitot Coefficient	0.831
Vapor Pressure of Water		2.91			
ZT		129.00	Duct Width (in.)		0
PM		154.75	Duct Length (in.)		0
Barometric Pressure		29.09	Duct Area (ft ²)		0
Standard Meter Volume			Stack Diameter (in.)		168
Moisture Content		5.33	Stack Area (ft ²)		153.94
O ₂ %		12.923	Molecular Weight (dry)		29.611
CO ₂ %		6.837	Molecular Weight (wet)		28.993
Standard CFH		4,818,967	Stack Pressure		29.061
K Standard CFH		80.316	Feet per Second		11.933
			Actual CFM		110213.15
			DSCFM		76039.26
<u>Flow Rate Data</u>					

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	13.00	0.11	10.78	10.70	12.92 dry
CO ₂ (wet)	6.52	0.05	8.35	8.30	6.47 wet
Moisture	5.33				
Fuel Factor C	1877				
DSCFM	76039				
			Standard CFH		4,818,967
			K Standard CFM		80.316

Results

Start Time	11:37 AM
Stop Time	11:43 AM
Standard CFH	4,819,000
CO ₂ %, wet	6.47
WAF applied	0.9900

Volumetric Flow Rate Data

Number of Sample Points			16	
<u>Point Number</u>	<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.031	244	11:44 AM
2	A-2	0.033	244	
3	A-3	0.030	244	
4	A-4	0.029	244	
5	B-1	0.027	245	
6	B-2	0.034	245	
7	B-3	0.034	245	
8	B-4	0.032	245	
9	C-1	0.031	244	
10	C-2	0.034	244	
11	C-3	0.035	244	
12	C-4	0.033	244	
13	D-1	0.034	244	
14	D-2	0.038	244	
15	D-3	0.035	244	
16	D-4	0.035	244	11:50 AM
Average		0.033	0.181	244

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	244	
Wet Bulb (°F)	114.0	Static Pressure
TRA	1.17	Pitot Coefficient
Vapor Pressure of Water	2.91	
ZT	130.00	Duct Width (in.)
PM	153.70	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	5.29	168.00
O ₂ %	12.923	Stack Area (ft ²)
CO ₂ %	6.834	153.94
Standard CFH	4,696,221	Molecular Weight (dry)
K Standard CFH	78.27	29.61
		Molecular Weight (wet)
		28.996
		Stack Pressure
		29.06
		Feet per Second
		11.638
		Actual CFM
		107487.6
		DSCFM
		74130.52

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>	
O ₂ (dry)	13.00	0.11	10.78	10.70	12.92	dry
CO ₂ (wet)	6.52	0.05	8.35	8.30	6.47	wet
Moisture	5.29					
Fuel Factor C	1877					
DSCFM	74131					
					4,696,221	
					78.27	

Results

Start Time	11:44 AM
Stop Time	11:50 AM
Standard CFH	4,696,000
CO ₂ %, wet	6.47
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 4-6

Time	%O₂, d	% CO₂, w
11:30	12.75	6.731
11:31	12.9	6.457
11:32	13.17	6.439
11:33	12.9	6.618
11:34	12.89	6.506
11:35	13.01	6.484
11:36	13.17	6.344
11:37	13.1	6.66
11:38	12.94	6.471
11:39	13.14	6.675
11:40	12.93	6.501
11:41	13.06	6.6
11:42	13.08	6.463
11:43	13.09	6.648
11:44	12.86	6.463
11:45	13.09	6.544
11:46	12.98	6.67
11:47	12.79	6.555
11:48	12.98	6.504
11:49	12.97	6.508
11:50	13.07	6.482
11:51	13.06	6.543
11:52	13.04	6.587
11:53	13.01	6.848
11:54	12.67	6.687
11:55	12.84	6.606
11:56	12.93	6.505
11:57	13.08	6.532
11:58	13.02	6.501
11:59	12.85	6.598
12:00	12.91	6.587
12:01	12.98	6.474
12:02	12.99	6.559
12:03	13.05	6.356
12:04	13.18	6.408
12:05	13.14	6.598
12:06	12.92	6.56
12:07	12.95	6.437
12:08	13.05	6.515
12:09	12.91	6.501
12:10	13.05	6.397
12:11	13.01	6.426
12:12	13.11	6.317
12:13	13.03	6.645
12:14	12.85	6.521
12:15	13.05	6.364
12:16	13.08	6.396
12:17	13.1	6.317
12:18	13.1	6.505

Average **12.997** **6.523**

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 7
High Load (190 Klbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points 16

<u>Point Number</u>		<u>Delta_p</u>	<u>Sq. root delta_p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.034	0.184	243	
2	A-2	0.031	0.176	243	
3	A-3	0.032	0.179	243	
4	A-4	0.031	0.176	243	
5	B-1	0.033	0.182	243	
6	B-2	0.037	0.192	243	
7	B-3	0.038	0.195	243	
8	B-4	0.038	0.195	243	
9	C-1	0.033	0.182	244	
10	C-2	0.036	0.190	244	
11	C-3	0.036	0.190	244	
12	C-4	0.031	0.176	244	
13	D-1	0.035	0.187	244	
14	D-2	0.036	0.190	244	
15	D-3	0.037	0.192	244	
16	D-4	0.033	0.182	244	11:57 AM
Average		0.034	0.185	244	

Moisture Content Data

	<u>Flow Rate Data</u>
Dry Bulb (°F)	243
Wet Bulb (°F)	114.0
TRA	1.17
Vapor Pressure of Water	2.91
ZT	129.00
PM	154.77
Barometric Pressure	29.09
Standard Meter Volume	
Moisture Content	5.33
O ₂ %	12.923
CO ₂ %	6.837
Standard CFH	4,814,816
K Standard CFH	80.247
Static Pressure	-0.43
Pitot Coefficient	0.831
Duct Width (in.)	0.00
Duct Length (in.)	0.00
Duct Area (ft ²)	0.00
Stack Diameter (in.)	168.00
Stack Area (ft ²)	153.94
Molecular Weight (dry)	29.611
Molecular Weight (wet)	28.992
Stack Pressure	29.058
Feet per Second	11.919
Actual CFM	110090.24
DSCFM	75972.94

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	13.00	0.11	10.78	10.7	12.92 dry
CO ₂ (wet)	6.52	0.05	8.35	8.3	6.47 wet
Moisture	5.33				4,814,816
Fuel Factor C	1877				80.247
DSCFM	75973				

Results

Start Time	11:51 AM
Stop Time	11:57 AM
Standard CFH	4,815,000
CO ₂ %, wet	6.47
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 8
High Load (190 Klbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

Point Number		Delta p	Sq. root delta p	Temperature	Time
1	A-1	0.034	0.184	242	11:58 AM
2	A-2	0.030	0.173	242	
3	A-3	0.033	0.182	242	
4	A-4	0.028	0.167	242	
5	B-1	0.034	0.184	241	
6	B-2	0.033	0.182	241	
7	B-3	0.037	0.192	241	
8	B-4	0.039	0.197	241	
9	C-1	0.038	0.195	243	
10	C-2	0.036	0.190	243	
11	C-3	0.037	0.192	243	
12	C-4	0.035	0.187	243	
13	D-1	0.037	0.192	243	
14	D-2	0.035	0.187	243	
15	D-3	0.038	0.195	243	
16	D-4	0.036	0.190	243	12:04 PM
Average		0.035	0.187	242	

Moisture Content Data

	Flow Rate Data
Dry Bulb (°F)	242
Wet Bulb (°F)	114.0
TRA	1.17
Vapor Pressure of Water	2.91
ZT	128.00
PM	155.83
Barometric Pressure	29.09
Standard Meter Volume	
Moisture Content	5.36
O ₂ %	12.923
CO ₂ %	6.839
Standard CFH	4,857,304
K Standard CFH	80.955
Molecular Weight (dry)	
Molecular Weight (wet)	
Stack Pressure	
Feet per Second	
Actual CFM	
DSCFM	
29.611	
28.989	
29.058	
12,003	
110867.19	
76613.68	

Field Calculations

Raw Data Table

Instrument	ppm or %	Zero	Span	Cylinder Value	Gas Corrected for Calibration
O ₂ (dry)	13.00	0.11	10.78	10.7	12.92 dry
CO ₂ (wet)	6.52	0.05	8.35	8.3	6.47 wet
Moisture	5.36				
Fuel Factor C	1877				
DSCFM	76614				
Standard CFH		4,857,304			
K Standard CFM		80.955			

Results

Start Time	11:58 AM
Stop Time	12:04 PM
Standard CFH	4,857,000
CO ₂ %, wet	6.47
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 9
High Load (190 Klbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.031	0.176	241	12:05 PM
2	A-2	0.029	0.170	241	
3	A-3	0.030	0.173	241	
4	A-4	0.028	0.167	241	
5	B-1	0.036	0.190	243	
6	B-2	0.038	0.195	243	
7	B-3	0.039	0.197	243	
8	B-4	0.038	0.195	243	
9	C-1	0.035	0.187	242	
10	C-2	0.039	0.197	242	
11	C-3	0.033	0.182	242	
12	C-4	0.031	0.176	242	
13	D-1	0.034	0.184	242	
14	D-2	0.037	0.192	242	
15	D-3	0.038	0.195	242	
16	D-4	0.038	0.195	242	12:11 PM
Average		0.035	0.186	242	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	241	
Wet Bulb (°F)	114.0	Static Pressure
TRA	1.17	Pitot Coefficient
Vapor Pressure of Water	2.91	
ZT	127.00	Duct Width (in.)
PM	156.87	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	5.40	Stack Area (ft ²)
O ₂ %	12.923	Molecular Weight (dry)
CO ₂ %	6.842	Molecular Weight (wet)
Standard CFH	4,829,824	Stack Pressure
K Standard CFH	80,497	Feet per Second
		Actual CFM
		DSCFM

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	13.00	0.11	10.78	10.7	12.92 dry
CO ₂ (wet)	6.52	0.05	8.35	8.3	6.47 wet
Moisture	5.40				
Fuel Factor C	1877				
DSCFM	76152				
Standard CFH					4,829,824
K Standard CFM					80,497

Results

Start Time	12:05 PM
Stop Time	12:11 PM
Standard CFH	4,830,000
CO ₂ %, wet	6.47
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 7-9

Time	%O₂, d	% CO₂, w
11:30	12.75	6.731
11:31	12.9	6.457
11:32	13.17	6.439
11:33	12.9	6.618
11:34	12.89	6.506
11:35	13.01	6.484
11:36	13.17	6.344
11:37	13.1	6.66
11:38	12.94	6.471
11:39	13.14	6.675
11:40	12.93	6.501
11:41	13.06	6.6
11:42	13.08	6.463
11:43	13.09	6.648
11:44	12.86	6.463
11:45	13.09	6.544
11:46	12.98	6.67
11:47	12.79	6.555
11:48	12.98	6.504
11:49	12.97	6.508
11:50	13.07	6.482
11:51	13.06	6.543
11:52	13.04	6.587
11:53	13.01	6.848
11:54	12.67	6.687
11:55	12.84	6.606
11:56	12.93	6.505
11:57	13.08	6.532
11:58	13.02	6.501
11:59	12.85	6.598
12:00	12.91	6.587
12:01	12.98	6.474
12:02	12.99	6.559
12:03	13.05	6.356
12:04	13.18	6.408
12:05	13.14	6.598
12:06	12.92	6.56
12:07	12.95	6.437
12:08	13.05	6.515
12:09	12.91	6.501
12:10	13.05	6.397
12:11	13.01	6.426
12:12	13.11	6.317
12:13	13.03	6.645
12:14	12.85	6.521
12:15	13.05	6.364
12:16	13.08	6.396
12:17	13.1	6.317
12:18	13.1	6.505

Average **12.997** **6.523**

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1H Run 10
High Load (190 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.030	0.173	243	
2	A-2	0.032	0.179	243	
3	A-3	0.030	0.173	243	
4	A-4	0.032	0.179	243	
5	B-1	0.031	0.176	244	
6	B-2	0.033	0.182	244	
7	B-3	0.038	0.195	244	
8	B-4	0.033	0.182	244	
9	C-1	0.037	0.192	245	
10	C-2	0.037	0.192	245	
11	C-3	0.038	0.195	245	
12	C-4	0.033	0.182	245	
13	D-1	0.034	0.184	244	
14	D-2	0.035	0.187	244	
15	D-3	0.036	0.190	244	
16	D-4	0.036	0.190	244	12:18 PM
Average		0.034	0.184	244	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	243	
Wet Bulb (°F)	114.0	Static Pressure
TRA	1.17	Pitot Coefficient
Vapor Pressure of Water	2.91	
ZT	129.00	Duct Width (in.)
PM	154.75	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	5.33	Stack Area (ft ²)
O ₂ %	12.923	Molecular Weight (dry)
CO ₂ %	6.837	Molecular Weight (wet)
Standard CFH	4,786,451	Stack Pressure
K Standard CFH	79.774	Feet per Second
		Actual CFM
		DSCFM
		109508.36
		75526.17

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	13.00	0.11	10.78	10.7	12.92 dry
CO ₂ (wet)	6.52	0.05	8.35	8.3	6.47 wet
Moisture	5.33				
Fuel Factor C	1877				
DSCFM	75526				
					4,786,451
					79.774

Results

Start Time	12:12 PM
Stop Time	12:18 PM
Standard CFH	4,786,000
CO ₂ %, wet	6.47
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 10

<u>Time</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>
11:30	12.75	6.731
11:31	12.9	6.457
11:32	13.17	6.439
11:33	12.9	6.618
11:34	12.89	6.506
11:35	13.01	6.484
11:36	13.17	6.344
11:37	13.1	6.66
11:38	12.94	6.471
11:39	13.14	6.675
11:40	12.93	6.501
11:41	13.06	6.6
11:42	13.08	6.463
11:43	13.09	6.648
11:44	12.86	6.463
11:45	13.09	6.544
11:46	12.98	6.67
11:47	12.79	6.555
11:48	12.98	6.504
11:49	12.97	6.508
11:50	13.07	6.482
11:51	13.06	6.543
11:52	13.04	6.587
11:53	13.01	6.848
11:54	12.67	6.687
11:55	12.84	6.606
11:56	12.93	6.505
11:57	13.08	6.532
11:58	13.02	6.501
11:59	12.85	6.598
12:00	12.91	6.587
12:01	12.98	6.474
12:02	12.99	6.559
12:03	13.05	6.356
12:04	13.18	6.408
12:05	13.14	6.598
12:06	12.92	6.56
12:07	12.95	6.437
12:08	13.05	6.515
12:09	12.91	6.501
12:10	13.05	6.397
12:11	13.01	6.426
12:12	13.11	6.317
12:13	13.03	6.645
12:14	12.85	6.521
12:15	13.05	6.364
12:16	13.08	6.396
12:17	13.1	6.317
12:18	13.1	6.505

Average 12.997 6.523

Volumetric Flow Rate Data

Number of Sample Points			16		
Point Number		Delta p	Sq. root delta p	Temperature	Time
1	A-1	0.018	0.134	205	
2	A-2	0.016	0.126	205	
3	A-3	0.016	0.126	205	
4	A-4	0.019	0.138	205	
5	B-1	0.021	0.145	204	
6	B-2	0.024	0.155	204	
7	B-3	0.024	0.155	204	
8	B-4	0.022	0.148	204	
9	C-1	0.021	0.145	205	
10	C-2	0.025	0.158	205	
11	C-3	0.024	0.155	205	
12	C-4	0.022	0.148	205	
13	D-1	0.016	0.126	206	
14	D-2	0.019	0.138	206	
15	D-3	0.017	0.130	206	
16	D-4	0.015	0.122	206	5:25 AM
Average		0.020	0.141	205	
<u>Moisture Content Data</u>			<u>Flow Rate Data</u>		
Dry Bulb (°F)		205	Static Pressure		-0.39
Wet Bulb (°F)		108.0	Pitot Coefficient		0.831
TRA		1.18	Duct Width (in.)		0.0
Vapor Pressure of Water		2.45	Duct Length (in.)		0.0
ZT		97.00	Duct Area (ft ²)		0.0
PM		142.40	Stack Diameter (in.)		168.0
Barometric Pressure		29.09	Stack Area (ft ²)		153.938
Standard Meter Volume			Molecular Weight (dry)		29.802
Moisture Content		4.90	Molecular Weight (wet)		29.224
O ₂ %		11.404	Stack Pressure		29.061
CO ₂ %		8.414	Feet per Second		8.758
Standard CFH		3,742,879	Actual CFM		80888.82
K Standard CFH		62.381	DSCFM		59324.65

Field Calculations

Raw Data Table					
Instrument	ppm or %	Zero	Span	Cylinder Value	Gas Corrected for Calibration
O ₂ (dry)	11.55	0.17	10.85	10.70	11.40 dry
CO ₂ (wet)	8.04	0.04	8.34	8.30	8.00 wet
Moisture	4.90				3,742,879
Fuel Factor C	1877				62.381
DSCFM	59325				

Results

Start Time	5:15 AM
Stop Time	5:25 AM
Standard CFH	3,743,000
CO ₂ %, wet	8.00
WAF applied	0.9900

MSI / Manitowoc PU

Manitowoc, WI

S20 Boiler Stack

7/23/2013

Run 1

Time	%O₂, d	% CO₂, w
5:15	11.43	8.143
5:16	11.52	8.092
5:17	11.65	7.958
5:18	11.63	7.973
5:19	11.65	7.966
5:20	11.64	7.964
5:21	11.6	7.99
5:22	11.57	8.018
5:23	11.46	8.109
5:24	11.47	8.107
5:25	11.46	8.093
Average		11.553
		8.038

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 2
Low Load (80 Klbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta_p</u>	<u>Sq. root delta_p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.018	0.134	206	6:20 AM
2	A-2	0.019	0.138	206	
3	A-3	0.017	0.130	206	
4	A-4	0.016	0.126	206	
5	B-1	0.022	0.148	207	
6	B-2	0.023	0.152	207	
7	B-3	0.024	0.155	207	
8	B-4	0.021	0.145	207	
9	C-1	0.017	0.130	205	
10	C-2	0.019	0.138	205	
11	C-3	0.018	0.134	205	
12	C-4	0.019	0.138	205	
13	D-1	0.022	0.148	205	
14	D-2	0.021	0.145	205	
15	D-3	0.018	0.134	205	
16	D-4	0.017	0.130	205	6:30 AM
Average		0.019	0.139	206	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	206	
Wet Bulb (°F)	108.0	Static Pressure
TRA	1.18	Pitot Coefficient
Vapor Pressure of Water	2.45	
ZT	98.00	Duct Width (in.)
PM	141.34	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	4.86	Stack Area (ft ²)
O ₂ %	14.326	Molecular Weight (dry)
CO ₂ %	5.535	Molecular Weight (wet)
Standard CFH	3,720,136	Stack Pressure
K Standard CFH	62.002	Feet per Second
		Actual CFM
		DSCFM

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>	
O ₂ (dry)	14.47	0.14	10.84	10.70	14.33	dry
CO ₂ (wet)	5.30	0.06	8.32	8.30	5.27	wet
Moisture	4.86				3,720,136	
Fuel Factor C	1877				62.002	
DSCFM	58987					

Results

Start Time	6:20 AM
Stop Time	6:30 AM
Standard CFH	3,720,000
CO ₂ %, wet	5.27
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 3
Low Load (80 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta_p</u>	<u>Sq. root delta_p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.014	0.118	207	
2	A-2	0.016	0.126	207	
3	A-3	0.016	0.126	207	
4	A-4	0.015	0.122	207	
5	B-1	0.024	0.155	207	
6	B-2	0.021	0.145	207	
7	B-3	0.022	0.148	207	
8	B-4	0.020	0.141	207	
9	C-1	0.025	0.158	206	
10	C-2	0.023	0.152	206	
11	C-3	0.022	0.148	206	
12	C-4	0.021	0.145	206	
13	D-1	0.020	0.141	207	
14	D-2	0.019	0.138	207	
15	D-3	0.018	0.134	207	
16	D-4	0.017	0.130	207	6:38 AM
Average		0.020	0.139	207	

Moisture Content Data

Dry Bulb (°F)	207	Flow Rate Data	
Wet Bulb (°F)	108.0	Static Pressure	-0.40
TRA	1.18	Pitot Coefficient	0.831
Vapor Pressure of Water	2.45	Duct Width (in.)	0.00
ZT	99.00	Duct Length (in.)	0.00
PM	140.29	Duct Area (ft ²)	0.00
Barometric Pressure	29.09	Stack Diameter (in.)	168.00
Standard Meter Volume		Stack Area (ft ²)	153.94
Moisture Content	4.83	Molecular Weight (dry)	29.461
O ₂ %	14.393	Molecular Weight (wet)	28.908
CO ₂ %	5.533	Stack Pressure	29.061
Standard CFH	3,722,674	Feet per Second	8.734
K Standard CFH	62.045	Actual CFM	80665.91
		DSCFM	59049.44

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.47	0.14	10.79	10.70	14.39 dry
CO ₂ (wet)	5.30	0.06	8.32	8.30	5.27 wet
Moisture	4.83				
Fuel Factor C	1877				
DSCFM	59049				
Standard CFH				3,722,674	
K Standard CFM				62.045	

Results

Start Time	6:31 AM
Stop Time	6:38 AM
Standard CFH	3,723,000
CO ₂ %, wet	5.27
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 4
Low Load (80 Klbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

Point Number		Delta p	Sq. root <u>delta p</u>	Temperature	Time
1	A-1	0.014	0.118	207	6:39 AM
2	A-2	0.015	0.122	207	
3	A-3	0.017	0.130	207	
4	A-4	0.014	0.118	207	
5	B-1	0.019	0.138	208	
6	B-2	0.020	0.141	208	
7	B-3	0.023	0.152	208	
8	B-4	0.019	0.138	208	
9	C-1	0.018	0.134	208	
10	C-2	0.018	0.134	207	
11	C-3	0.019	0.138	207	
12	C-4	0.017	0.130	207	
13	D-1	0.020	0.141	207	
14	D-2	0.016	0.126	207	
15	D-3	0.016	0.126	207	
16	D-4	0.017	0.130	207	6:46 AM
Average		0.018	0.132	207	

Moisture Content Data

		Flow Rate Data
Dry Bulb (°F)	207	
Wet Bulb (°F)	108.0	Static Pressure
TRA	1.18	Pitot Coefficient
Vapor Pressure of Water	2.45	
ZT	99.00	Duct Width (in.)
PM	140.28	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	4.83	Stack Area (ft ²)
O ₂ %	14.378	Molecular Weight (dry)
CO ₂ %	5.531	Molecular Weight (wet)
Standard CFH	3,536,707	Stack Pressure
K Standard CFH	58.945	Feet per Second
		Actual CFM
		DSCFM

Field Calculations

Raw Data Table

Instrument	ppm or %	Zero	Span	Cylinder Value	Gas Corrected for Calibration	
O ₂ (dry)	14.47	0.09	10.79	10.70	14.38	dry
CO ₂ (wet)	5.30	0.06	8.32	8.30	5.26	wet
Moisture	4.83				3,536,707	
Fuel Factor C	1877				58.945	
DSCFM	56100					

Results

Start Time	6:39 AM
Stop Time	6:46 AM
Standard CFH	3,537,000
CO ₂ %, wet	5.26
WAF applied	0.9900

MSI / Manitowoc PU

Manitowoc, WI

S20 Boiler Stack

7/23/2013

Run 2-4

Time	%O₂, d	% CO₂, w
6:20	14.73	5.616
6:21	14.68	5.6
6:22	14.54	5.525
6:23	14.42	5.337
6:24	14.64	5.068
6:25	15.03	5.18
6:26	14.39	5.525
6:27	14.26	5.518
6:28	14.23	5.484
6:29	14.21	5.57
6:30	14.13	5.524
6:31	14.16	5.465
6:32	14.14	5.537
6:33	14.2	4.767
6:34	15.23	4.566
6:35	14.75	5.491
6:36	14.09	5.553
6:37	14.03	5.54
6:38	14.01	5.481
6:39	14.25	5.289
6:40	14.42	4.996
6:41	15.01	3.928
6:42	15.62	5.245
6:43	14.46	5.314
6:44	14.32	5.32
6:45	14.35	5.328
6:46	14.33	5.298

Average **14.468** **5.299**

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 5
Low Load (80 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points 16

<u>Point Number</u>		<u>Delta_p</u>	<u>Sq. root delta_p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.016	0.126	208	
2	A-2	0.018	0.134	208	
3	A-3	0.019	0.138	208	
4	A-4	0.019	0.138	208	
5	B-1	0.022	0.148	208	
6	B-2	0.019	0.138	208	
7	B-3	0.018	0.134	208	
8	B-4	0.020	0.141	208	
9	C-1	0.020	0.141	208	
10	C-2	0.023	0.152	208	
11	C-3	0.025	0.158	208	
12	C-4	0.023	0.152	208	
13	D-1	0.017	0.130	207	
14	D-2	0.018	0.134	207	
15	D-3	0.017	0.130	207	
16	D-4	0.016	0.126	207	7:10 AM
Average		0.019	0.139	208	

Moisture Content Data

	<u>Flow Rate Data</u>
Dry Bulb (°F)	208
Wet Bulb (°F)	108.0
TRA	1.18
Vapor Pressure of Water	2.45
ZT	100.00
PM	139.23
Barometric Pressure	29.09
Standard Meter Volume	
Moisture Content	4.79
O ₂ %	14.836
CO ₂ %	4.928
Standard.CFH	3,711,463
K Standard CFH	61.858
<u>Molecular Weight (dry)</u>	
<u>Molecular Weight (wet)</u>	
<u>Stack Pressure</u>	
<u>Feet per Second</u>	
<u>Actual CFM</u>	
<u>DSCFM</u>	

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>	
O ₂ (dry)	14.90	0.10	10.78	10.70	14.84	dry
CO ₂ (wet)	4.75	0.08	8.35	8.30	4.69	wet
Moisture	4.79					
Fuel Factor C	1877					
DSCFM	58894					
<u>Standard CFH</u>		<u>3,711,463</u>		<u>61.858</u>		

Results

<u>Start Time</u>	7:02 AM
<u>Stop Time</u>	7:10 AM
<u>Standard CFH</u>	3,711,000
<u>CO₂ %, wet</u>	4.69
<u>WAF applied</u>	0.9900

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.016	0.126	207	
2	A-2	0.018	0.134	207	
3	A-3	0.018	0.134	207	
4	A-4	0.019	0.138	207	
5	B-1	0.018	0.134	208	
6	B-2	0.019	0.138	208	
7	B-3	0.017	0.130	208	
8	B-4	0.019	0.138	208	
9	C-1	0.022	0.148	206	
10	C-2	0.023	0.152	206	
11	C-3	0.025	0.158	206	
12	C-4	0.021	0.145	206	
13	D-1	0.018	0.134	206	
14	D-2	0.017	0.130	206	
15	D-3	0.018	0.134	206	
16	D-4	0.016	0.126	206	7:16 AM
Average		0.019	0.138	207	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	207	
Wet Bulb (°F)	108.0	Static Pressure
TRA	1.18	Pitot Coefficient
Vapor Pressure of Water	2.45	
ZT	99.00	Duct Width (in.)
PM	140.28	Duct Length (in.)
Barometric Pressure	29.09	Duct Area (ft ²)
Standard Meter Volume		Stack Diameter (in.)
Moisture Content	4.83	Stack Area (ft ²)
O ₂ %	14.861	Molecular Weight (dry)
CO ₂ %	4.905	Molecular Weight (wet)
Standard CFH	3,679,142	Stack Pressure
K Standard CFH	61.319	Feet per Second
		Actual CFM
		DSCFM
		29.379
		28.83
		29.061
		8.631
		79720.61
		58359.07

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>	
O ₂ (dry)	14.90	0.11	10.76	10.70	14.86	dry
CO ₂ (wet)	4.75	0.09	8.38	8.30	4.67	wet
Moisture	4.83				3,679,142	
Fuel Factor C	1877				61.319	
DSCFM	58359					

Results

Start Time	7:11 AM
Stop Time	7:16 AM
Standard CFH	3,679,000
CO ₂ %, wet	4.67
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 7
Low Load (80 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.018	0.134	209	7:17 AM
2	A-2	0.019	0.138	209	
3	A-3	0.017	0.130	209	
4	A-4	0.019	0.138	209	
5	B-1	0.020	0.141	209	
6	B-2	0.018	0.134	209	
7	B-3	0.019	0.138	209	
8	B-4	0.019	0.138	209	
9	C-1	0.023	0.152	210	
10	C-2	0.024	0.155	210	
11	C-3	0.025	0.158	210	
12	C-4	0.022	0.148	210	
13	D-1	0.018	0.134	210	
14	D-2	0.016	0.126	210	
15	D-3	0.016	0.126	210	
16	D-4	0.017	0.130	210	7:24 AM
Average		0.019	0.139	210	
<u>Moisture Content Data</u>					
Dry Bulb (°F)		209			
Wet Bulb (°F)		108.0			
TRA		1.18	Static Pressure	-0.38	
Vapor Pressure of Water		2.45	Pitot Coefficient	0.831	
ZT		101.00	Duct Width (in.)	0.00	
PM		138.16	Duct Length (in.)	0.00	
Barometric Pressure		29.09	Duct Area (ft ²)	0.00	
Standard Meter Volume			Stack Diameter (in.)	168.00	
Moisture Content		4.75	Stack Area (ft ²)	153.94	
O ₂ %		14.861	Molecular Weight (dry)	29.379	
CO ₂ %		4.901	Molecular Weight (wet)	28.838	
Standard CFH		3,706,056	Stack Pressure	29.062	
K Standard CFH		61.768	Feet per Second	8.73	
			Actual CFM	80632.95	
			DSCFM	58831.09	

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.90	0.11	10.76	10.7	14.86 dry
CO ₂ (wet)	4.75	0.09	8.38	8.3	4.67 wet
Moisture Fuel Factor C					
DSCFM	4.75				
	1877				
	58831				
			Standard CFH	3,706,056	
			K Standard CFM	61.768	

Results

Start Time	7:17 AM
Stop Time	7:24 AM
Standard CFH	3,706,000
CO ₂ %, wet	4.67
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 5-7

<u>Time</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>
7:02	14.54	5.041
7:03	14.57	5.039
7:04	14.47	5.171
7:05	14.41	5.155
7:06	14.47	4.949
7:07	15.29	3.507
7:08	16.3	3.729
7:09	15.52	5.115
7:10	14.51	5.055
7:11	14.55	5.167
7:12	14.6	4.13
7:13	15.92	3.904
7:14	15.41	5.109
7:15	14.51	5.042
7:16	14.57	5.066
7:17	14.51	5.134
7:18	14.53	4.975
7:19	14.58	5.126
7:20	14.54	4.735
7:21	15.33	3.941
7:22	15.78	4.625
7:23	14.8	4.898
7:24	15.02	4.7
Average	14.901	4.753

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 8
Low Load (80 KIbs/Hr)

Volumetric Flow Rate Data

Number of Sample Points

16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.020	0.141	211	7:42 AM
2	A-2	0.018	0.134	211	
3	A-3	0.019	0.138	211	
4	A-4	0.019	0.138	211	
5	B-1	0.019	0.138	210	
6	B-2	0.017	0.130	210	
7	B-3	0.018	0.134	210	
8	B-4	0.018	0.134	210	
9	C-1	0.020	0.141	210	
10	C-2	0.020	0.141	210	
11	C-3	0.019	0.138	210	
12	C-4	0.020	0.141	210	
13	D-1	0.017	0.130	209	
14	D-2	0.016	0.126	209	
15	D-3	0.016	0.126	209	
16	D-4	0.016	0.126	209	7:49 AM
Average		0.018	0.135	210	
<u>Moisture Content Data</u>					
Dry Bulb (°F)		211			
Wet Bulb (°F)		108.0		Static Pressure	-0.39
TRA		1.18		Pilot Coefficient	0.831
Vapor Pressure of Water		2.45			
ZT		103.00		Duct Width (in.)	0.00
PM		136.05		Duct Length (in.)	0.00
Barometric Pressure		29.09		Duct Area (ft ²)	0.00
Standard Meter Volume				Stack Diameter (in.)	168.00
Moisture Content		4.68		Stack Area (ft ²)	153.94
O ₂ %		14.797		Molecular Weight (dry)	29.389
CO ₂ %		4.985		Molecular Weight (wet)	28.856
Standard CFH		3,599,669		Stack Pressure	29.061
K Standard CFH		59.994		Feet per Second	8.486
				Actual CFM	78378.76
				DSCFM	57185.83

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.84	0.11	10.76	10.7	14.80 dry
CO ₂ (wet)	4.83	0.09	8.37	8.3	4.75 wet
Moisture	4.68				
Fuel Factor C	1877				
DSCFM	57186				
				Standard CFH	3,599,669
				K Standard CFM	59.994

Results

Start Time	7:42 AM
Stop Time	7:49 AM
Standard CFH	3,600,000
CO ₂ %, wet	4.75
WAF applied	0.9900

Volumetric Flow Rate Data

Number of Sample Points 16

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.017	0.130	212	
2	A-2	0.019	0.138	212	
3	A-3	0.019	0.138	212	
4	A-4	0.018	0.134	212	
5	B-1	0.019	0.138	212	
6	B-2	0.018	0.134	212	
7	B-3	0.018	0.134	212	
8	B-4	0.019	0.138	212	
9	C-1	0.020	0.141	211	
10	C-2	0.020	0.141	211	
11	C-3	0.019	0.138	211	
12	C-4	0.021	0.145	211	
13	D-1	0.017	0.130	210	
14	D-2	0.017	0.130	210	
15	D-3	0.017	0.130	210	
16	D-4	0.018	0.134	210	7:57 AM
Average		0.019	0.136	211	

Moisture Content Data

		<u>Flow Rate Data</u>
Dry Bulb (°F)	212	
Wet Bulb (°F)	108.0	Static Pressure -0.39
TRA	1.18	Pitot Coefficient 0.831
Vapor Pressure of Water	2.45	
ZT	104.00	Duct Width (in.) 0.00
PM	134.99	Duct Length (in.) 0.00
Barometric Pressure	29.09	Duct Area (ft ²) 0.00
Standard Meter Volume		Stack Diameter (in.) 168.00
Moisture Content	4.65	Stack Area (ft ²) 153.94
O ₂ %	14.797	Molecular Weight (dry) 29.39
CO ₂ %	4.991	Molecular Weight (wet) 28.861
Standard CFH	3,621,588	Stack Pressure 29.061
K Standard CFH	60.36	Feet per Second 8.554
		Actual CFM 79003.15
		DSCFM 57556.03

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.84	0.11	10.76	10.7	14.80 dry
CO ₂ (wet)	4.83	0.08	8.36	8.3	4.76 wet
Moisture	4.65				
Fuel Factor C	1877				
DSCFM	57556				
				3,621,588	
				60.36	

Results

<u>Start Time</u>	7:50 AM
<u>Stop Time</u>	7:57 AM
<u>Standard CFH</u>	3,622,000
<u>CO₂ %, wet</u>	4.76
<u>WAF applied</u>	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 10
Low Load (80 Kibs/Hr)

Volumetric Flow Rate Data

Number of Sample Points **16**

<u>Point Number</u>		<u>Delta p</u>	<u>Sq. root delta p</u>	<u>Temperature</u>	<u>Time</u>
1	A-1	0.018	0.134	210	7:58 AM
2	A-2	0.019	0.138	210	
3	A-3	0.019	0.138	210	
4	A-4	0.019	0.138	210	
5	B-1	0.017	0.130	210	
6	B-2	0.018	0.134	210	
7	B-3	0.018	0.134	210	
8	B-4	0.020	0.141	210	
9	C-1	0.019	0.138	211	
10	C-2	0.022	0.148	211	
11	C-3	0.023	0.152	211	
12	C-4	0.021	0.145	211	
13	D-1	0.018	0.134	209	
14	D-2	0.017	0.130	209	
15	D-3	0.016	0.126	209	
16	D-4	0.017	0.130	209	8:06 AM
Average		0.019	0.137	210	

Moisture Content Data

Dry Bulb (°F)	210
Wet Bulb (°F)	108.0
TRA	1.18
Vapor Pressure of Water	2.45
ZT	102.00
PM	137.11
Barometric Pressure	29.09
Standard Meter Volume	
Moisture Content	4.72
O ₂ %	14.797
CO ₂ %	4.995
Standard CFH	3,653,496
K Standard CFH	60.892

Flow Rate Data

Static Pressure	-0.39
Pitot Coefficient	0.831
Duct Width (in.)	0.00
Duct Length (in.)	0.00
Duct Area (ft ²)	0.00
Stack Diameter (in.)	168.00
Stack Area (ft ²)	153.94
Molecular Weight (dry)	29.391
Molecular Weight (wet)	28.854
Stack Pressure	29.061
Feet per Second	8.613
Actual CFM	79550.78
DSCFM	58018.77

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>	
O ₂ (dry)	14.84	0.11	10.76	10.7	14.80	dry
CO ₂ (wet)	4.83	0.08	8.36	8.3	4.76	wet
Moisture	4.72					
Fuel Factor C	1877					
DSCFM	58019					
					3,653,496	
					60.892	

Results

Start Time	7:58 AM
Stop Time	8:06 AM
Standard CFH	3,653,000
CO ₂ %, wet	4.76
WAF applied	0.9900

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 8-10

<u>Time</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>
7:42	14.66	4.958
7:43	14.57	5.065
7:44	15.01	3.617
7:45	16.42	3.507
7:46	16.04	4.917
7:47	14.45	5.355
7:48	14.31	5.228
7:49	14.31	5.276
7:50	14.26	5.297
7:51	14.3	5.197
7:52	14.38	5.274
7:53	14.27	5.185
7:54	15.11	3.524
7:55	16.3	3.997
7:56	15.23	5.128
7:57	14.45	5.109
7:58	14.49	5.182
7:59	14.44	5.006
8:00	15.12	3.698
8:01	16.19	4.06
8:02	15.17	5.21
8:03	14.38	5.209
8:04	14.38	5.298
8:05	14.33	5.239
8:06	14.38	5.156
Average	14.838	4.828

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 1
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.87	0.15	10.83	10.70	14.75
CO ₂ (wet)	4.87	0.02	8.29	8.30	4.86
NOx (wet)	21.73	0.08	50.30	50.40	21.74
SO ₂ (wet)	43.03	0.17	48.81	49.60	43.71
CO (wet)	38.320	0.12	50.33	50.80	38.65
Moisture	12.38				
Fuel Factor	1877				
DSCFM					

Results

Gases Start	2:50 PM
Gases Stop	3:10 PM
CO ₂ %, wet	4.9
NOX ppm, wet	21.7
NOx LB/mmBTU	0.100
SO ₂ ppm, wet	43.7
SO ₂ LB/mmBTU	0.280
CO ppm, wet	38.7
CO LB/mmBTU	0.108

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 1

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>	<u>CO ppm, w</u>
14:50	44.94	22.02	14.88	5.007	37.6
14:51	43.99	22.37	14.73	4.921	38.32
14:52	42.76	21.79	14.8	4.997	41.21
14:53	42.51	21.89	14.8	4.873	38.21
14:54	43.42	21.93	14.9	4.877	40.52
14:55	42.63	21.86	14.98	4.782	37.68
14:56	42.27	21.99	14.98	4.897	39.65
14:57	43.72	22.24	14.84	4.956	38.1
14:58	43.29	21.89	14.87	4.91	39.8
14:59	43.39	21.22	14.84	4.913	38.08
15:00	44.74	22.05	14.87	5.078	37.43
15:01	43.44	20.97	14.76	4.933	39.23
15:02	43.12	21.06	14.85	4.903	37.83
15:03	43.24	20.85	14.91	4.868	38.99
15:04	43.5	21.4	14.92	4.887	38.26
15:05	44.63	21.08	14.92	4.953	37.28
15:06	43.66	21.35	14.92	4.893	36.11
15:07	40.82	20.74	15.01	4.707	36.58
15:08	41.18	21.41	15.01	4.914	37.23
15:09	42.76	21.75	14.91	4.846	38.35
15:10	39.62	24.56	14.57	4.11	38.27
Average	43.030	21.734	14.870	4.868	38.320

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L **Run 2**
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.54	0.14	10.85	10.70	14.39
CO ₂ (wet)	4.87	0.05	8.28	8.30	4.87
NOx (wet)	21.17	0.11	50.14	50.40	21.22
SO ₂ (wet)	41.77	0.07	49.10	49.60	42.19
CO (wet)	37.228	0.15	49.69	50.80	38.02
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM					

Results

Gases Start	3:20 PM
Gases Stop	3:40 PM
CO ₂ %, wet	4.9
NOX ppm, wet	21.2
NOx LB/mmBTU	0.098
SO ₂ ppm, wet	42.2
SO ₂ LB/mmBTU	0.270
CO ppm, wet	38.0
CO LB/mmBTU	0.107

MSI / Manitowoc PU

Manitowoc, WI

S20 Boiler Stack

7/23/2013

Run 2

Time	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>	<u>CO ppm, w</u>
15:20	43.99	21.18	14.17	5.051	35.33
15:21	43.29	20.58	14.07	4.904	34.75
15:22	41.46	21.45	14.29	4.841	35.86
15:23	40.24	21.62	14.29	4.885	36.32
15:24	41.64	21.16	14.24	4.868	37.42
15:25	41.45	21.8	14.31	4.826	35.62
15:26	40.82	20.73	14.35	4.678	38.88
15:27	40.87	20.88	14.49	4.767	36.25
15:28	39.6	21.37	14.56	4.808	36.29
15:29	42.01	21.2	14.4	4.82	36.13
15:30	42.92	20.78	14.49	4.825	37.12
15:31	42.09	20.63	14.52	4.861	37.93
15:32	44.55	20.89	14.54	4.918	38.12
15:33	44.1	20.57	14.54	4.839	38.01
15:34	41.49	21.57	14.56	4.808	36.98
15:35	41.25	21.69	14.6	4.877	38.02
15:36	42.39	21.38	14.52	4.807	38.51
15:37	41.18	21.46	14.95	4.827	36.68
15:38	40.81	21.43	15.13	4.93	39.14
15:39	40.54	21.08	15.07	5.086	39.12
15:40	40.55	21.12	15.26	5.046	39.30
Average	41.773	21.170	14.541	4.870	37.228

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 3
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.67	0.14	10.83	10.7	14.54
CO ₂ (wet)	5.03	0.05	8.28	8.3	5.02
NOx (wet)	20.06	0.08	49.93	50.4	20.21
SO ₂ (wet)	44.28	0.10	49.81	49.6	44.08
CO (wet)	39.414	0.14	49.41	50.80	40.49
Moisture	0.15				
Fuel Factor	1877				
DSCFM					

Results

Gases Start	3:50 PM
Gases Stop	4:10 PM
CO ₂ %, wet	5.0
NOX ppm, wet	20.2
NOx LB/mmBTU	0.090
SO ₂ ppm, wet	44.1
SO ₂ LB/mmBTU	0.274
CO ppm, wet	40.5
CO LB/mmBTU	0.110

MSI / Manitowoc PU

Manitowoc, WI

S20 Boiler Stack

7/23/2013

Run 3

Time	SO₂ ppm, w	Nox ppm, w	%O₂, d	% CO₂, w	CO ppm, w
15:50	40.39	20.49	14.38	5.12	38.91
15:51	43.26	19.54	14.36	5.171	39.48
15:52	44.77	20.54	14.32	5.146	40.87
15:53	45.08	20.3	14.5	5.092	40.05
15:54	46.22	20.04	14.69	5.2	39.19
15:55	46.84	19.85	14.64	4.996	38.17
15:56	48.18	19.48	14.78	5.111	39.66
15:57	47.45	20.12	14.76	4.97	40.22
15:58	47.58	19.95	14.81	4.897	41.09
15:59	47.97	20.11	14.82	4.985	41.94
16:00	47.07	20.06	14.71	4.866	40.54
16:01	45.14	20.5	14.75	5.04	41.02
16:02	43.53	20.01	14.72	4.993	40.65
16:03	42.35	20.43	14.72	4.975	40.11
16:04	42.01	20.57	14.69	5.077	38.97
16:05	41.91	20.41	14.67	5.102	39.43
16:06	40.63	20.32	14.66	4.931	38.03
16:07	42.87	19.99	14.81	4.987	38.86
16:08	43.57	19.36	14.69	5.054	37.55
16:09	41.56	19.67	14.76	4.903	36.51
16:10	41.41	19.61	14.73	4.97	36.45
Average	44.276	20.064	14.665	5.028	39.414

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 4
Low "Normal" Load (80 KIbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.63	0.16	10.81	10.7	14.54
CO ₂ (wet)	5.06	0.04	8.23	8.3	5.09
NOx (wet)	19.80	0.07	50.00	50.4	19.92
SO ₂ (wet)	40.97	0.13	49.84	49.6	40.76
CO (wet)	36.961	0.15	49.58	50.80	37.84
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM					

Results

Gases Start	4:20 PM
Gases Stop	4:40 PM
CO₂ %, wet	5.1
NOX ppm, wet	19.9
NOx LB/mmBTU	0.088
SO₂ ppm, wet	40.8
SO₂ LB/mmBTU	0.249
CO ppm, wet	37.8
CO LB/mmBTU	0.101

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 4

Time	SO₂ ppm, w	Nox ppm, w	%O₂, d	% CO₂, w	CO ppm, w
16:20	41.32	19.98	13.36	5.022	38.53
16:21	41.77	19.85	14.44	5.009	37.96
16:22	40.46	19.73	14.72	5.017	35.9
16:23	40.89	19.4	14.73	5.128	34.99
16:24	39.6	19.93	14.72	4.995	34.79
16:25	38.92	20.52	14.73	5.023	35.03
16:26	39.1	19.95	14.74	5.043	37.03
16:27	39.58	20.21	14.73	5.027	35.38
16:28	40.82	19.45	14.69	5.078	36.87
16:29	39.62	19.99	14.71	5.093	36.9
16:30	39.8	19.69	14.69	5.026	37.94
16:31	39.92	19.69	14.77	5.044	36.76
16:32	40.36	19.41	14.7	5.055	38.21
16:33	40.01	19.92	14.74	5.065	36.55
16:34	41.64	19.78	14.65	5.06	35.5
16:35	40.92	19.64	14.78	5.015	38.82
16:36	41.72	19.78	14.72	5.098	37.61
16:37	42.87	20.02	14.63	5.177	38.91
16:38	44.15	19.58	14.62	5.119	38.14
16:39	44.36	19.63	14.59	5.129	38.25
16:40	42.57	19.69	14.7	5.097	36.12
Average	40.971	19.802	14.627	5.063	36.961

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 5
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.76	0.16	10.81	10.7	14.67
CO ₂ (wet)	5.00	0.04	8.22	8.3	5.03
NOx (wet)	19.54	0.10	50.05	50.4	19.61
SO ₂ (wet)	40.34	0.10	49.69	49.6	40.25
CO (wet)	35.466	0.16	49.79	50.80	36.14
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM					

Results

Gases Start	4:50 PM
Gases Stop	5:10 PM
CO ₂ %, wet	5.0
NOX ppm, wet	19.6
NOx LB/mmBTU	0.087
SO ₂ ppm, wet	40.2
SO ₂ LB/mmBTU	0.249
CO ppm, wet	36.1
CO LB/mmBTU	0.098

MSI / Manitowoc PU

Manitowoc, WI

S20 Boiler Stack

7/23/2013

Run 5

Time	SO_x ppm, w	Nox ppm, w	%O₂, d	% CO₂, w	CO ppm, w
16:50	39.24	19.61	14.74	5.03	34.3
16:51	39.18	19.83	14.75	5.135	33.36
16:52	38.27	20.14	14.67	5.018	36.2
16:53	38.34	20.35	14.71	5.089	36.55
16:54	40.59	19.58	14.65	5.039	36.59
16:55	40.62	19.56	14.78	5.114	36.48
16:56	40.57	19.9	14.71	4.945	34.65
16:57	41.07	18.66	14.81	4.942	35.15
16:58	42	19.65	14.84	5.116	33.46
16:59	42.5	19.11	14.68	4.932	36.79
17:00	40.37	19.38	14.86	5.026	36.66
17:01	40.15	19.33	14.74	5.082	36.52
17:02	39.51	18.93	14.67	5.002	34.35
17:03	38.96	18.91	14.8	4.94	36.28
17:04	38.98	19.4	14.84	4.927	34.13
17:05	39.66	19.24	14.84	5.054	36.07
17:06	41.8	19.12	14.71	5.069	35.48
17:07	41.28	19.49	14.69	5.069	34.64
17:08	41.57	18.72	14.74	4.975	34.98
17:09	40.89	18.92	14.88	4.861	36.56
17:10	41.51	22.42	14.81	4.551	35.59
Average	40.336	19.536	14.758	4.996	35.466

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 6
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.64	0.14	10.79	10.7	14.57
CO ₂ (wet)	5.18	0.07	8.24	8.3	5.19
NOx (wet)	19.48	0.13	49.87	50.4	19.61
SO ₂ (wet)	40.34	0.07	49.24	49.6	40.63
CO (wet)	35.756	0.16	49.86	50.80	36.39
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM					

Results

Gases Start	5:20 PM
Gases Stop	5:40 PM
CO ₂ %, wet	5.2
NOX ppm, wet	19.6
NOx LB/mmBTU	0.085
SO ₂ ppm, wet	40.6
SO ₂ LB/mmBTU	0.244
CO ppm, wet	36.4
CO LB/mmBTU	0.096

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 6

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>	<u>CO ppm, w</u>
17:20	43.19	19.47	14.61	5.259	34.47
17:21	42.36	19.07	14.54	5.055	34.84
17:22	41.01	19.9	14.68	5.154	32.91
17:23	40.5	19.52	14.64	5.089	37.57
17:24	40.33	19.09	14.72	5.029	35.59
17:25	39.39	19.2	14.74	5.091	34.93
17:26	40.8	19.01	14.8	5.104	34.55
17:27	41.98	19.13	14.64	5.013	35.17
17:28	41.9	19.66	14.74	5.104	33.66
17:29	41.17	19.72	14.71	5.055	36.19
17:30	41.29	19.6	14.69	5.088	34.97
17:31	38.67	19.19	14.7	5.218	35.97
17:32	37.99	19.32	14.76	5.034	34.68
17:33	37.18	19.62	14.83	5.109	35.57
17:34	37.93	19.57	14.68	5.314	35.71
17:35	39.27	20.15	14.58	5.356	36.34
17:36	39.06	19.84	14.55	5.293	36.92
17:37	40.17	19.83	14.59	5.343	35.91
17:38	39.98	19.83	14.57	5.351	38.63
17:39	41.61	19.23	14.54	5.306	38.48
17:40	41.37	19.14	14.22	5.34	37.82
Average	40.340	19.480	14.644	5.176	35.756

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 7
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.17	0.14	10.81	10.7	14.07
CO ₂ (wet)	5.17	0.07	8.26	8.3	5.17
NOx (wet)	19.40	0.13	49.58	50.4	19.64
SO ₂ (wet)	41.77	0.08	48.83	49.6	42.43
CO (wet)	36.489	0.14	49.64	50.80	37.31
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM	0				

Results

Gases Start	5:50 PM
Gases Stop	6:10 PM
CO ₂ %, wet	5.2
NOX ppm, wet	19.6
NOx LB/mmBTU	0.085
SO ₂ ppm, wet	42.4
SO ₂ LB/mmBTU	0.256
CO ppm, wet	37.3
CO LB/mmBTU	0.098

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 7

Time	SO₂ ppm, w	Nox ppm, w	%O₂, d	% CO₂, w	CO ppm, w
17:50	43.3	18.77	14.09	5.265	38.8
17:51	42.61	18.8	14.16	5.149	35.8
17:52	43.16	18.84	14.18	5.23	36.62
17:53	43.52	19.48	14.16	5.307	36.18
17:54	40.14	19.36	14.08	5.227	37.23
17:55	38.99	19.4	14.16	5.162	36.18
17:56	41.93	19.03	14.08	5.174	34.23
17:57	40.97	19.45	14.11	5.189	33.16
17:58	41.84	19.14	14.1	5.154	36.58
17:59	42.74	19.42	14.09	5.205	37.12
18:00	43.05	19.91	14.04	5.186	36.7
18:01	42.49	19.16	14.06	5.117	35.45
18:02	42.03	19.57	14.25	4.96	35.84
18:03	42.59	19.53	14.26	5.089	38.65
18:04	42.84	20.23	14.19	5.19	38.42
18:05	41.06	20.09	14.12	5.178	38.08
18:06	40.51	19.63	14.24	5.191	36.78
18:07	41.42	19.52	14.25	5.064	35
18:08	41.26	19.14	14.39	5.23	36.02
18:09	40.41	19.58	14.24	5.176	37.53
18:10	40.41	19.4	14.32	5.127	35.89
Average	41.775	19.402	14.170	5.170	36.489

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 8
Low "Normal" Load (80 KIbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.33	0.15	10.80	10.7	14.25
CO ₂ (wet)	5.09	0.03	8.25	8.3	5.12
NOx (wet)	19.71	0.14	49.61	50.4	19.94
SO ₂ (wet)	41.93	0.12	49.11	49.6	42.33
CO (wet)	35.670	0.16	49.77	50.80	36.37
Moisture Fuel Factor DSCFM	0.15 1877			Standard CFH K Standard CFM	

Results

Gases Start	6:20 PM
Gases Stop	6:40 PM
CO ₂ %, wet	5.1
NOX ppm, wet	19.9
NOx LB/mmBTU	0.087
SO ₂ ppm, wet	42.3
SO ₂ LB/mmBTU	0.258
CO ppm, wet	36.4
CO LB/mmBTU	0.097

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 8

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>	<u>CO ppm, w</u>
18:20	42.6	19.17	14.22	5.008	36.91
18:21	42.65	19.63	14.32	5.148	37.49
18:22	43.66	19.36	14.3	5.174	35.12
18:23	41.97	19.1	14.27	5.027	35.1
18:24	41.88	19.62	14.38	5.107	37.22
18:25	44.91	19.02	14.32	5.117	36.26
18:26	46.07	19.41	14.33	5.079	36.13
18:27	44.91	19.82	14.29	5.058	36.35
18:28	42.83	20.12	14.38	5.049	37.94
18:29	39.53	19.34	14.37	5.008	35.59
18:30	40.55	20.33	14.38	5.171	35.04
18:31	42.01	19.29	14.31	5.172	35.98
18:32	41.21	19.02	14.31	5.043	35.76
18:33	40.56	19.67	14.36	5.174	37.11
18:34	38.85	19.62	14.28	5.1	34.36
18:35	41.54	19.38	14.33	4.989	32.31
18:36	40.43	19.86	14.41	5.177	35.12
18:37	42.39	19.15	14.26	5.056	33.49
18:38	40.6	19.74	14.38	5.014	33.88
18:39	39.35	19.89	14.44	5.104	35.7
18:40	41.94	23.45	14.31	5.144	36.21
Average	41.926	19.714	14.331	5.091	35.670

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 9
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.51	0.14	10.75	10.7	14.49
CO ₂ (wet)	5.13	0.03	8.25	8.3	5.16
NOx (wet)	20.06	0.14	49.58	50.4	20.32
SO ₂ (wet)	42.08	0.18	49.25	49.6	42.35
CO (wet)	35.261	0.15	50.04	50.80	35.75
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM					

Results

Gases Start	6:50 PM
Gases Stop	7:10 PM
CO ₂ %, wet	5.2
NOX ppm, wet	20.3
NOx LB/mmBTU	0.088
SO ₂ ppm, wet	42.3
SO ₂ LB/mmBTU	0.256
CO ppm, wet	35.8
CO LB/mmBTU	0.095

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Run 9

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>	<u>CO ppm, w</u>
18:50	41.02	19.82	14.49	5.077	32.49
18:51	40.05	20.3	14.52	5.113	33.1
18:52	40.92	20.38	14.45	5.179	36.15
18:53	45.08	19.83	14.46	5.137	36.87
18:54	45.64	20.03	14.49	5.104	34.34
18:55	42.78	20.34	14.48	5.18	35.54
18:56	42.51	20.17	14.42	5.192	34.53
18:57	43.38	19.78	14.5	5.103	35.42
18:58	42.71	20.7	14.5	5.078	36.62
18:59	40.62	19.87	14.63	5.005	36.41
19:00	40.92	19.67	14.62	5.041	34.07
19:01	42.36	20.05	14.57	5.151	35.69
19:02	44.26	20.1	14.52	5.174	37.7
19:03	42.35	20.24	14.43	5.193	36.69
19:04	43.33	19.28	14.48	5.116	36.85
19:05	43.13	20.1	14.52	5.169	34.49
19:06	40.53	19.81	14.52	5.094	34.92
19:07	42.34	19.88	14.51	5.161	34.96
19:08	39.36	20.4	14.52	5.164	35.56
19:09	39.69	19.84	14.49	5.123	33.72
19:10	40.61	20.76	14.54	5.234	34.37
Average	42.076	20.064	14.508	5.133	35.261

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack

7/23/2013
Test 1L Run 10
Low "Normal" Load (80 Klbs/Hr)

Field Calculations

Raw Data Table

<u>Instrument</u>	<u>ppm or %</u>	<u>Zero</u>	<u>Span</u>	<u>Cylinder Value</u>	<u>Gas Corrected for Calibration</u>
O ₂ (dry)	14.22	0.15	10.78	10.7	14.16
CO ₂ (wet)	5.16	0.02	8.24	8.3	5.20
NOx (wet)	20.15	0.13	49.58	50.4	20.41
SO ₂ (wet)	41.87	0.17	48.97	49.6	42.38
CO (wet)	36.271	0.13	49.97	50.80	36.84
Moisture	0.15				Standard CFH
Fuel Factor	1877				K Standard CFM
DSCFM					

Results

Gases Start	7:20 PM
Gases Stop	7:40 PM
CO ₂ %, wet	5.2
NOX ppm, wet	20.4
NOx LB/mmbtu	0.088
SO ₂ ppm, wet	42.4
SO ₂ LB/mmbtu	0.254
WAF applied	0.9900
CO ppm, wet	36.8
CO LB/mmbtu	0.097

MSI / Manitowoc PU

Manitowoc, WI

S20 Boiler Stack

7/23/2013

Run 10

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>	<u>CO ppm, w</u>
19:20	42.31	20.21	14.15	5.171	38.31
19:21	43.6	19.68	14.23	5.066	36.86
19:22	43.33	20.28	14.18	5.178	37.1
19:23	40.14	19.68	14.21	5.053	34.84
19:24	42.25	20.34	14.2	5.228	36.49
19:25	44.55	19.83	14.16	5.086	37.82
19:26	44.65	20.05	14.28	5.07	37.08
19:27	41.87	20.21	14.27	5.073	35.51
19:28	43.74	19.91	14.24	5.182	36.5
19:29	45.8	20.06	14.16	5.121	35.73
19:30	42.63	20.33	14.27	5.173	38.16
19:31	40.23	20.41	14.28	5.162	36.66
19:32	38.52	20.63	14.22	5.27	36.07
19:33	40.08	20.15	14.13	5.199	36.13
19:34	39.98	20.09	14.21	5.134	33.84
19:35	38.76	20.25	14.22	5.236	34
19:36	40.63	20.16	14.28	5.169	35.4
19:37	39.4	20.15	14.21	5.225	36.41
19:38	39.96	20.21	14.18	5.214	37.58
19:39	43.09	20.4	14.2	5.17	35.88
19:40	43.71	20.06	14.24	5.219	35.33
Average	41.868	20.147	14.215	5.162	36.271

APPENDIX C

FIELD DATA SHEETS

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU					
Source	S20 Boiler Stack					
Test	1H	Run	1	Date	7/23/2013	
Stack Diameter (in.)				168		
Dry Bulb (°F)	240			Wet Bulb (°F)	113	
Moisture Content (%)				5.12		
Monometer	Expanded					
Barometric Pressure	29.09					
Static Pressure +/-	-0.39					
Operators	Aaron Wilson / Nate Beinemann					
Pitot No.	04-5+-P1			Pitot Coeff.	0.8310	
High Load (190 Klbs/Hr)						
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)	
		Port Length (in.):	14.00		Start Time:	10:40 AM
A-1	0.032	5.38	19.38	0.033	240	
A-2	0.105	17.64	31.64	0.032	240	
A-3	0.194	32.59	46.59	0.034	240	
A-4	0.323	54.26	68.26	0.039	240	
B-1				0.037	241	
B-2				0.033	241	
B-3				0.032	241	
B-4				0.031	241	
C-1				0.035	243	
C-2				0.033	243	
C-3				0.031	243	
C-4				0.030	243	
D-1				0.036	240	
D-2				0.033	240	
D-3				0.030	240	
D-4				0.031	240	
Digital Numbers Used: 85 / 138						
					End Time:	10:46 AM

Interpoll Laboratories
(763) 786-6020
CFR 112 Emissions & Field Data Sheet

Job	MSI / Manitowoc PU					
Source	S20 Boiler Stack					
Test	1H	Run	2	Date	7/23/2013	
Stack Diameter (in.)					168	
Dry Bulb (°F)	246				Wet Bulb (°F)	113
Moisture Content (%)					4.90	
Monometer					Expanded	
Barometric Pressure					29.09	
Static Pressure +/-					-0.39	
Operators					Aaron Wilson / Nate Beinemann	
Pitot No.	04-5+P1				Pitot Coeff.	0.8310
					High Load (190 Kilbs/Hr)	
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)	
		Port Length (in.):	14.00	Start Time:	10:47 AM	
A-1	0.032	5.38	19.38	0.029	246	
A-2	0.105	17.64	31.64	0.033	246	
A-3	0.194	32.59	46.59	0.031	246	
A-4	0.323	54.26	68.26	0.034	246	
B-1				0.031	247	
B-2				0.032	247	
B-3				0.034	247	
B-4				0.033	247	
C-1				0.035	247	
C-2				0.034	247	
C-3				0.037	247	
C-4				0.038	247	
D-1				0.034	247	
D-2				0.035	247	
D-3				0.037	247	
D-4				0.036	247	
Digital Numbers Used:	85 / 138			End Time:	10:53 AM	

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job Source	MSI / Manitowoc PU				Cross-section View	Elevation View
	S20 Boiler Stack	Run	Date	7/23/2013		
Test	1H	3				
Stack Diameter (in.)			168			
Dry Bulb (°F)	247		Wet Bulb (°F)	113		
Moisture Content (%)				4.86		
Monometer			Expanded			
Barometric Pressure			29.09			
Static Pressure +/-			-0.40			
Operators	Aaron Wilson / Nate Beinemann					
Pitot No.	04-5+-P1		Pitot Coeff.	0.8310		
High Load (190 Klbs/Hr)						
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)	
		Port Length (in.):	14.00		Start Time:	10:54 AM
A-1	0.032	5.38	19.38	0.034	247	
A-2	0.105	17.64	31.64	0.038	247	
A-3	0.194	32.59	46.59	0.036	247	
A-4	0.323	54.26	68.26	0.032	247	
B-1				0.034	247	
B-2				0.035	247	
B-3				0.038	247	
B-4				0.031	247	
C-1				0.032	246	
C-2				0.034	246	
C-3				0.035	246	
C-4				0.036	246	
D-1				0.035	246	
D-2				0.031	246	
D-3				0.032	246	
D-4				0.033	246	
Digital Numbers Used:	85 / 138			End Time:	11:00 AM	

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU					
Source	S20 Boiler Stack					
Test	1H	Run	4	Date	7/23/2013	
Stack Diameter (in.)	168					
Dry Bulb (°F)	242				Wet Bulb (°F)	114
Moisture Content (%)	5.36					
Monometer	Expanded					
Barometric Pressure	29.09					
Static Pressure +/-	-0.41					
Operators	Aaron Wilson / Nate Beinemann					
Pitot No.	04-5+-P1				Pitot Coeff.	0.8310
High Load (190 Klbs/Hr)						
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)	
		Port Length (in.):	14.00	Start Time:	11:30 AM	
A-1	0.032	5.38	19.38	0.032	242	
A-2	0.105	17.64	31.64	0.033	242	
A-3	0.194	32.59	46.59	0.028	242	
A-4	0.323	54.26	68.26	0.030	242	
B-1				0.032	244	
B-2				0.034	244	
B-3				0.032	244	
B-4				0.035	244	
C-1				0.031	244	
C-2				0.033	244	
C-3				0.034	244	
C-4				0.035	244	
D-1				0.033	243	
D-2				0.034	243	
D-3				0.035	243	
D-4				0.036	243	
Digital Numbers Used:			85 / 138	End Time:	11:36 AM	

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU			
Source	S20 Boiler Stack			
Test	1H	Run	5	Date 7/23/2013
Stack Diameter (in.)			168	
Dry Bulb (°F)		243	Wet Bulb (°F)	114
Moisture Content (%)			5.33	
Monometer	Expanded			
Barometric Pressure	29.09			
Static Pressure +/-	-0.39			
Operators	Aaron Wilson / Nate Beinemann			
Pitot No.	04-5+-P1	Pitot Coeff.	0.8310	

High Load (190 Klbs/Hr)

Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
	Port Length (in.):	14.00		Start Time:	11:37 AM
A-1	0.032	5.38	19.38	0.035	243
A-2	0.105	17.64	31.64	0.033	243
A-3	0.194	32.59	46.59	0.035	243
A-4	0.323	54.26	68.26	0.032	243
B-1				0.034	244
B-2				0.038	244
B-3				0.037	244
B-4				0.035	244
C-1				0.034	244
C-2				0.035	244
C-3				0.036	244
C-4				0.034	244
D-1				0.028	244
D-2				0.034	244
D-3				0.036	244
D-4				0.036	244
Digital Numbers Used:	85 / 138		End Time:	11:43 AM	

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1H	Run	6	Date	7/23/2013
Stack Diameter (in.)	168				
Dry Bulb (°F)	244	Wet Bulb (°F)			114
Moisture Content (%)	5.29				
Monometer	Expanded				
Barometric Pressure	29.09				
Static Pressure +/-	-0.41				
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1		Pitot Coeff. 0.8310		
High Load (190 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00		Start Time: 11:44 AM
A-1	0.032	5.38	19.38	0.031	244
A-2	0.105	17.64	31.64	0.033	244
A-3	0.194	32.59	46.59	0.030	244
A-4	0.323	54.26	68.26	0.029	244
B-1				0.027	245
B-2				0.034	245
B-3				0.034	245
B-4				0.032	245
C-1				0.031	244
C-2				0.034	244
C-3				0.035	244
C-4				0.033	244
D-1				0.034	244
D-2				0.038	244
D-3				0.035	244
D-4				0.035	244
Digital Numbers Used:		85 / 138		End Time:	11:50 AM

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU					
Source	S20 Boiler Stack					
Test	1H	Run	7	Date	7/23/2013	
Stack Diameter (in.)				168		
Dry Bulb (°F)	243			Wet Bulb (°F)	114	
Moisture Content (%)				5.33		
Monometer				Expanded		
Barometric Pressure				29.09		
Static Pressure +/-				-0.43		
Operators	Aaron Wilson / Nate Beinemann					
Pitot No.	04-5+-P1			Pitot Coeff.	0.8310	

High Load (190 Kilbs/Hr)

Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
Port Length (in.):				Start Time:	11:51 AM
A-1	0.032	5.38	19.38	0.034	243
A-2	0.105	17.64	31.64	0.031	243
A-3	0.194	32.59	46.59	0.032	243
A-4	0.323	54.26	68.26	0.031	243
B-1				0.033	243
B-2				0.037	243
B-3				0.038	243
B-4				0.038	243
C-1				0.033	244
C-2				0.036	244
C-3				0.036	244
C-4				0.031	244
D-1				0.035	244
D-2				0.036	244
D-3				0.037	244
D-4				0.033	244
Digital Numbers Used:					
85 / 138				End Time:	11:57 AM

Interpoll Laboratories
 (763) 786-6020
EPA Method 2 Field Data Sheet

Job Source	MSI / Manitowoc PU				
Test	S20 Boiler Stack				
Stack Diameter (in.)	1H	Run	8	Date	7/23/2013
Dry Bulb (°F)			168		
Moisture Content (%)	242		Wet Bulb (°F)	114	
Monometer			5.36		
Barometric Pressure			Expanded		
Static Pressure +/-			29.09		
Operators			-0.44		
Pitot No.	04-5+-P1		Pitot Coeff.	0.8310	
High Load (190 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00		Start Time: 11:58 AM
A-1	0.032	5.38	19.38	0.034	242
A-2	0.105	17.64	31.64	0.030	242
A-3	0.194	32.59	46.59	0.033	242
A-4	0.323	54.26	68.26	0.028	242
B-1				0.034	241
B-2				0.033	241
B-3				0.037	241
B-4				0.039	241
C-1				0.038	243
C-2				0.036	243
C-3				0.037	243
C-4				0.035	243
D-1				0.037	243
D-2				0.035	243
D-3				0.038	243
D-4				0.036	243
Digital Numbers Used:	85 / 138		End Time:	12:04 PM	

Interpol Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU			
Source	S20 Boiler Stack			
Test	1H	Run	9	Date
Stack Diameter (in.)				7/23/2013
Dry Bulb (°F)	168			
Moisture Content (%)	241			Wet Bulb (°F) 114
Monometer				5.40
Barometric Pressure				Expanded
Static Pressure +/-				29.09
Operators				-0.40
Pitot No.	04-5+-P1			Aaron Wilson / Nate Beinemann
				Pitot Coeff. 0.8310

High Load (190 Klbs/Hr)

Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	12:05 PM
A-1	0.032	5.38	19.38	0.031	241
A-2	0.105	17.64	31.64	0.029	241
A-3	0.194	32.59	46.59	0.030	241
A-4	0.323	54.26	68.26	0.028	241
B-1				0.036	243
B-2				0.038	243
B-3				0.039	243
B-4				0.038	243
C-1				0.035	242
C-2				0.039	242
C-3				0.033	242
C-4				0.031	242
D-1				0.034	242
D-2				0.037	242
D-3				0.038	242
D-4				0.038	242
Digital Numbers Used:	85 / 138		End Time:	12:11 PM	

Interpoll Laboratories
 (763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1H	Run	10	Date	
Stack Diameter (in.)				7/23/2013	
Dry Bulb ($^{\circ}$ F)			168		
	243		Wet Bulb ($^{\circ}$ F)	114	
Moisture Content (%)				5.33	
Monometer		Expanded			
Barometric Pressure		29.09			
Static Pressure +/-		-0.39			
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1	Pitot Coeff.	0.8310		
					High Load (190 Klbs/Hr)
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas ($^{\circ}$ F)
Port Length (in.):			14.00	Start Time:	12:12 PM
A-1	0.032	5.38	19.38	0.030	243
A-2	0.105	17.64	31.64	0.032	243
A-3	0.194	32.59	46.59	0.030	243
A-4	0.323	54.26	68.26	0.032	243
B-1				0.031	244
B-2				0.033	244
B-3				0.038	244
B-4				0.033	244
C-1				0.037	245
C-2				0.037	245
C-3				0.038	245
C-4				0.033	245
D-1				0.034	244
D-2				0.035	244
D-3				0.036	244
D-4				0.036	244
Digital Numbers Used:		85 / 138		End Time:	12:18 PM

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1L	Run	1	Date	
Stack Diameter (in.)				7/23/2013	
Dry Bulb (°F)	205			168	
Moisture Content (%)				Wet Bulb (°F) 108	
Monometer				4.90	
Barometric Pressure				Expanded	
Static Pressure +/-				29.09	
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1		Pitot Coeff.	0.8310	
Low Load (80 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	5:15 AM
A-1	0.032	5.38	19.38	0.018	205
A-2	0.105	17.64	31.64	0.016	205
A-3	0.194	32.59	46.59	0.016	205
A-4	0.323	54.26	68.26	0.019	205
B-1				0.021	204
B-2				0.024	204
B-3				0.024	204
B-4				0.022	204
C-1				0.021	205
C-2				0.025	205
C-3				0.024	205
C-4				0.022	205
D-1				0.016	206
D-2				0.019	206
D-3				0.017	206
D-4				0.015	206 ,
Digital Numbers Used:		85 / 138	End Time:	5:25 AM	

Interpoli Laboratories
 (763) 786-6020
EPA Method 2 Field Data Sheet

Job Source	MSI / Manitowoc PU			Cross-section View	Elevation View
Test	1L	Run 2	Date 7/23/2013		
Stack Diameter (in.)			168		
Dry Bulb (°F)	206		Wet Bulb (°F) 108		
Moisture Content (%)			4.86		
Monometer			Expanded		
Barometric Pressure			29.09		
Static Pressure +/-			-0.39		
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1		Pitot Coeff. 0.8310		
Low Load (80 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	6:20 AM
A-1	0.032	5.38	19.38	0.018	206
A-2	0.105	17.64	31.64	0.019	206
A-3	0.194	32.59	46.59	0.017	206
A-4	0.323	54.26	68.26	0.016	206
B-1				0.022	207
B-2				0.023	207
B-3				0.024	207
B-4				0.021	207
C-1				0.017	205
C-2				0.019	205
C-3				0.018	205
C-4				0.019	205
D-1				0.022	205
D-2				0.021	205
D-3				0.018	205
D-4				0.017	205
Digital Numbers Used: 85 / 138 || End Time: 6:30 AM					

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU			
Source	S20 Boiler Stack			
Test	1L	Run	3	Date
Stack Diameter (in.)			168	7/23/2013
Dry Bulb (°F)	207	Wet Bulb (°F)	108	
Moisture Content (%)			4.83	
Monometer				
Barometric Pressure			Expanded	
Static Pressure +/-			29.09	
Operators			-0.40	
Pitot No.	Aaron Wilson / Nate Beinemann			
04-5+-P1	Pitot Coeff.	0.8310		

Low Load (80 Klbs/Hr)

Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
	Port Length (in.):	14.00		Start Time:	6:31 AM
A-1	0.032	5.38	19.38	0.014	207
A-2	0.105	17.64	31.64	0.016	207
A-3	0.194	32.59	46.59	0.016	207
A-4	0.323	54.26	68.26	0.015	207
B-1				0.024	207
B-2				0.021	207
B-3				0.022	207
B-4				0.020	207
C-1				0.025	206
C-2				0.023	206
C-3				0.022	206
C-4				0.021	206
D-1				0.020	207
D-2				0.019	207
D-3				0.018	207
D-4				0.017	207
Digital Numbers Used:	85 / 138		End Time:	6:38 AM	

Interpoll Laboratories
(763) 786-6020

EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1L	Run	4	Date	7/23/2013
Stack Diameter (in.)	168			Cross-section	View
Dry Bulb (°F)	207	Wet Bulb (°F)	108	View	
Moisture Content (%)	4.83				
Monometer	Expanded				
Barometric Pressure	29.09				
Static Pressure +/-	-0.39				
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1			Pitot Coeff.	0.8310
Low Load (80 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	6:39 AM
A-1	0.032	5.38	19.38	0.014	207
A-2	0.105	17.64	31.64	0.015	207
A-3	0.194	32.59	46.59	0.017	207
A-4	0.323	54.26	68.26	0.014	207
B-1				0.019	208
B-2				0.020	208
B-3				0.023	208
B-4				0.019	208
C-1				0.018	208
C-2				0.018	207
C-3				0.019	207
C-4				0.017	207
D-1				0.020	207
D-2				0.016	207
D-3				0.016	207
D-4				0.017	207
Digital Numbers Used:	85 / 138			End Time:	6:46 AM

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1L	Run	5	Date	7/23/2013
Stack Diameter (in.)			168		
Dry Bulb (°F)	208		Wet Bulb (°F)	108	
Moisture Content (%)	4.79				
Monometer	Expanded				
Barometric Pressure	29.09				
Static Pressure +/-	-0.39				
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1		Pitot Coeff.	0.8310	
Low Load (80 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	7:02 AM
A-1	0.032	5.38	19.38	0.016	208
A-2	0.105	17.64	31.64	0.018	208
A-3	0.194	32.59	46.59	0.019	208
A-4	0.323	54.26	68.26	0.019	208
B-1				0.022	208
B-2				0.019	208
B-3				0.018	208
B-4				0.020	208
C-1				0.020	208
C-2				0.023	208
C-3				0.025	208
C-4				0.023	208
D-1				0.017	207
D-2				0.018	207
D-3				0.017	207
D-4				0.016	207
Digital Numbers Used:			85 / 138	End Time:	7:10 AM

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1L	Run	6	Date	
Stack Diameter (in.)	168				
Dry Bulb (°F)	207	Wet Bulb (°F)	108		
Moisture Content (%)	4.83				
Monometer	Expanded				
Barometric Pressure	29.09				
Static Pressure +/-	-0.39				
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1 Pitot Coeff. 0.8310				
Low Load (80 Kibs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	7:11 AM
A-1	0.032	5.38	19.38	0.016	207
A-2	0.105	17.64	31.64	0.018	207
A-3	0.194	32.59	46.59	0.018	207
A-4	0.323	54.26	68.26	0.019	207
B-1				0.018	208
B-2				0.019	208
B-3				0.017	208
B-4				0.019	208
C-1				0.022	206
C-2				0.023	206
C-3				0.025	206
C-4				0.021	206
D-1				0.018	206
D-2				0.017	206
D-3				0.018	206
D-4				0.016	206
Digital Numbers Used:		85 / 138	End Time:	7:16 AM	

Interpoll Laboratories
(763) 786-6020

Job	MSI / Manitowoc PU		
Source	S20 Boiler Stack		
Test	1L	Run	7
Stack Diameter (in.)		Date	7/23/2013
Dry Bulb (°F)	209	Wet Bulb (°F)	108
Moisture Content (%)		4.75	
Monometer		Expanded	
Barometric Pressure		29.09	
Static Pressure +/-		-0.38	
Operators	Aaron Wilson / Nate Beinemann		
Pitot No.	04-5+-P1	Pitot Coeff.	0.8310

The diagram consists of two vertical columns separated by a vertical line. The left column is labeled "Cross-section View" and the right column is labeled "Elevation View".

Low Load (80 Klbs/Hr)

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1L	Run	8	Date	
Stack Diameter (in.)				7/23/2013	
Dry Bulb (°F)	211		Wet Bulb (°F)	108	
Moisture Content (%)				4.68	
Monometer				Expanded	
Barometric Pressure				29.09	
Static Pressure +/-				-0.39	
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1		Pitot Coeff.	0.8310	
Low Load (80 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	7:42 AM
A-1	0.032	5.38	19.38	0.020	211
A-2	0.105	17.64	31.64	0.018	211
A-3	0.194	32.59	46.59	0.019	211
A-4	0.323	54.26	68.26	0.019	211
B-1				0.019	210
B-2				0.017	210
B-3				0.018	210
B-4				0.018	210
C-1				0.020	210
C-2				0.020	210
C-3				0.019	210
C-4				0.020	210
D-1				0.017	209
D-2				0.016	209
D-3				0.016	209
D-4				0.016	209
Digital Numbers Used:		85 / 138	End Time:	7:49 AM	

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack			Cross-section	Elevation
Test	1L	Run	9	Date	7/23/2013
Stack Diameter (in.)			168		
Dry Bulb (°F)	212		Wet Bulb (°F)	108	
Moisture Content (%)				4.65	
Monometer			Expanded		
Barometric Pressure			29.09		
Static Pressure +/-			-0.39		
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1	Pitot Coeff.			0.8310
Low Load (80 Klbs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	7:50 AM
A-1	0.032	5.38	19.38	0.017	212
A-2	0.105	17.64	31.64	0.019	212
A-3	0.194	32.59	46.59	0.019	212
A-4	0.323	54.26	68.26	0.018	212
B-1				0.019	212
B-2				0.018	212
B-3				0.018	212
B-4				0.019	212
C-1				0.020	211
C-2				0.020	211
C-3				0.019	211
C-4				0.021	211
D-1				0.017	210
D-2				0.017	210
D-3				0.017	210
D-4				0.018	210
Digital Numbers Used: 85 / 138 End Time: 7:57 AM					

Interpoll Laboratories
(763) 786-6020
EPA Method 2 Field Data Sheet

Job	MSI / Manitowoc PU				
Source	S20 Boiler Stack				
Test	1L	Run	10	Date	
Stack Diameter (in.)	168				
Dry Bulb (°F)	210 Wet Bulb (°F) 108				
Moisture Content (%)	4.72				
Monometer	Expanded				
Barometric Pressure	29.09				
Static Pressure +/-	-0.39				
Operators	Aaron Wilson / Nate Beinemann				
Pitot No.	04-5+-P1 Pitot Coeff. 0.8310				
Low Load (80 Kibs/Hr)					
Traverse Point Number	Fraction of Diameter	Distance From Stack Wall (in.)	Distance From End of Port (in.)	Velocity	Temperature of Gas (°F)
		Port Length (in.):	14.00	Start Time:	7:58 AM
A-1	0.032	5.38	19.38	0.018	210
A-2	0.105	17.64	31.64	0.019	210
A-3	0.194	32.59	46.59	0.019	210
A-4	0.323	54.26	68.26	0.019	210
B-1				0.017	210
B-2				0.018	210
B-3				0.018	210
B-4				0.020	210
C-1				0.019	211
C-2				0.022	211
C-3				0.023	211
C-4				0.021	211
D-1				0.018	209
D-2				0.017	209
D-3				0.016	209
D-4				0.017	209
Digital Numbers Used:		85 / 138		End Time:	8:06 AM

APPENDIX D

MEASUREMENT SYSTEM PERFORMANCE SPECIFICATIONS

Calibration Error

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Test 1L

SO₂(TEI Model 43i)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	% of Span
Zero	0.00	0.27	0.27	112.00	0.24
Mid Level	49.60	49.10	0.50	112.00	0.45
High Level	112.00	112.30	0.30	112.00	0.27

CO (TEI Model 43i)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	% of Span
Zero	0.00	0.06	0.06	50.80	0.12
Mid Level	50.80	50.67	0.13	50.80	0.26
High Level	114.00	114.80	0.80	114.00	0.70

NOx (TEI Model 42i)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	% of Span
Zero	0.00	0.03	0.03	113.00	0.03
Mid Level	50.40	50.22	0.18	113.00	0.16
High Level	113.00	114.60	1.60	113.00	1.42

CO₂ (TEI Model 410i)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (%)	% of Span
Zero	0.00	0.03	0.03	16.73	0.18
Mid Level	8.30	8.35	0.05	16.73	0.31
High Level	16.73	16.78	0.05	16.73	0.30

O₂ (Servomex Series 1400)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (%)	% of Span
Zero	0.00	0.15	0.15	21.40	0.70
Mid Level	10.70	10.81	0.11	21.40	0.51
High Level	21.40	21.14	0.26	21.40	1.21

**** All Calibrations must be within 2% of the span value...

Calibration Drift

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Test 1L

		O₂					
		Initial	Pre-Cal Bias	Final	Post-cal Bias	Avg.	% Drift of Span
1	Zero	0.15	0.00%	0.15	0.00%	0.15	0.00%
	Upscale	10.81	0.00%	10.85	0.19%	10.83	0.19%
2	Zero	0.15	0.00%	0.12	-0.14%	0.14	-0.14%
	Upscale	10.85	0.19%	10.85	0.19%	10.85	0.00%
3	Zero	0.12	-0.14%	0.15	0.00%	0.14	0.14%
	Upscale	10.85	0.19%	10.80	-0.05%	10.83	-0.23%
4	Zero	0.15	0.00%	0.16	0.05%	0.16	0.05%
	Upscale	10.80	-0.05%	10.81	0.00%	10.81	0.05%
5	Zero	0.16	0.05%	0.15	0.00%	0.16	-0.05%
	Upscale	10.81	0.00%	10.80	-0.05%	10.81	-0.05%
6	Zero	0.15	0.00%	0.13	-0.09%	0.14	-0.09%
	Upscale	10.80	-0.05%	10.78	-0.14%	10.79	-0.09%
7	Zero	0.13	-0.09%	0.15	0.00%	0.14	0.09%
	Upscale	10.78	-0.14%	10.84	0.14%	10.81	0.28%
8	Zero	0.15	0.00%	0.15	0.00%	0.15	0.00%
	Upscale	10.84	0.14%	10.75	-0.28%	10.80	-0.42%
9	Zero	0.15	0.00%	0.12	-0.14%	0.14	-0.14%
	Upscale	10.75	-0.28%	10.75	-0.28%	10.75	0.00%
10	Zero	0.12	-0.14%	0.18	0.14%	0.15	0.28%
	Upscale	10.75	-0.28%	10.80	-0.05%	10.78	0.23%

		Cylinder Value	Analyzer Value
		Zero	10.70 %	10.81 %
	Span	21.40 %	21.40 %

** All Drift Calibrations must be within 3% of the span value...

** All Bias Calibrations must be within 5% of the span value...

Calibration Drift

MSI / Manitowoc PU
 Manitowoc, WI
 S20 Boiler Stack
 7/23/2013
 Test 1L

		CO ₂					
		Initial	Pre-Cal Bias	Final	Post-Cal Bias	Avg.	% Drift of Span
1	Zero	0.03	0.00%	0.01	-0.12%	0.02	-0.12%
	Upscale	8.35	0.00%	8.23	-0.73%	8.29	-0.73%
2	Zero	0.01	-0.12%	0.08	0.30%	0.05	0.42%
	Upscale	8.23	-0.73%	8.32	-0.19%	8.28	0.54%
3	Zero	0.08	0.30%	0.02	-0.06%	0.05	-0.36%
	Upscale	8.32	-0.19%	8.24	-0.67%	8.28	-0.48%
4	Zero	0.02	-0.06%	0.05	0.12%	0.04	0.18%
	Upscale	8.24	-0.67%	8.22	-0.79%	8.23	-0.12%
5	Zero	0.05	0.12%	0.03	0.00%	0.04	-0.12%
	Upscale	8.22	-0.79%	8.21	-0.85%	8.22	-0.06%
6	Zero	0.03	0.00%	0.11	0.48%	0.07	0.48%
	Upscale	8.21	-0.85%	8.26	-0.55%	8.24	0.30%
7	Zero	0.11	0.48%	0.02	-0.06%	0.07	-0.54%
	Upscale	8.26	-0.55%	8.26	-0.55%	8.26	0.00%
8	Zero	0.02	-0.06%	0.03	0.00%	0.03	0.06%
	Upscale	8.26	-0.55%	8.23	-0.73%	8.25	-0.18%
9	Zero	0.03	0.00%	0.02	-0.06%	0.03	-0.06%
	Upscale	8.23	-0.73%	8.26	-0.55%	8.25	0.18%
10	Zero	0.02	-0.06%	0.01	-0.12%	0.02	-0.06%
	Upscale	8.26	-0.55%	8.21	-0.85%	8.24	-0.30%

	Cylinder Value	Analyzer Response
Zero	0.00 ppm	0.03 ppm
Upscale	8.30 ppm	8.35 ppm
Span	16.73 ppm	16.73 ppm

** All Drift Calibrations must be within 3% of the span value...

** All Bias Calibrations must be within 5% of the span value...

Calibration Drift

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Test 1L

Nox							
		Initial	Pre-Cal Bias	Final	Post-Cal Bias	Avg.	% Drift of Span
1	Zero	0.03	0.00%	0.12	0.08%	0.08	0.08%
	Upscale	50.22	0.00%	50.37	0.13%	50.30	0.13%
2	Zero	0.12	0.08%	0.09	0.05%	0.11	-0.03%
	Upscale	50.37	0.13%	49.91	-0.27%	50.14	-0.41%
3	Zero	0.09	0.05%	0.06	0.03%	0.08	-0.03%
	Upscale	49.91	-0.27%	49.95	-0.24%	49.93	0.04%
4	Zero	0.06	0.03%	0.07	0.04%	0.07	0.01%
	Upscale	49.95	-0.24%	50.05	-0.15%	50.00	0.09%
5	Zero	0.07	0.04%	0.13	0.09%	0.10	0.05%
	Upscale	50.05	-0.15%	50.04	-0.16%	50.05	-0.01%
6	Zero	0.13	0.09%	0.13	0.09%	0.13	0.00%
	Upscale	50.04	-0.16%	49.70	-0.46%	49.87	-0.30%
7	Zero	0.13	0.09%	0.13	0.09%	0.13	0.00%
	Upscale	49.70	-0.46%	49.45	-0.68%	49.58	-0.22%
8	Zero	0.13	0.09%	0.15	0.11%	0.14	0.02%
	Upscale	49.45	-0.68%	49.76	-0.41%	49.61	0.27%
9	Zero	0.15	0.11%	0.12	0.08%	0.14	-0.03%
	Upscale	49.76	-0.41%	49.39	-0.73%	49.58	-0.33%
10	Zero	0.12	0.08%	0.13	0.09%	0.13	0.01%
	Upscale	49.39	-0.73%	49.76	-0.41%	49.58	0.33%

	Cylinder Value	Analyzer Response
Zero	0.00 ppm	0.03 ppm
Upscale	50.40 ppm	50.22 ppm
Span	113.00 ppm	113.00 ppm

** All Drift Calibrations must be within 3% of the span value...
 ** All Bias Calibrations must be within 5% of the span value...

Calibration Drift

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Test 1L

		SO ₂					
		Initial	Pre-Cal Bias	Final	Post-Cal Bias	Avg.	% Drift of Span
1	Zero	0.27	0.00%	0.06	-0.19%	0.17	-0.19%
	Upscale	49.10	0.00%	48.52	-0.52%	48.81	-0.52%
2	Zero	0.06	-0.19%	0.08	-0.17%	0.07	0.02%
	Upscale	48.52	-0.52%	49.67	0.51%	49.10	1.03%
3	Zero	0.08	-0.17%	0.11	-0.14%	0.10	0.03%
	Upscale	49.67	0.51%	49.94	0.75%	49.81	0.24%
4	Zero	0.11	-0.14%	0.14	-0.12%	0.13	0.03%
	Upscale	49.94	0.75%	49.73	0.56%	49.84	-0.19%
5	Zero	0.14	-0.12%	0.05	-0.20%	0.10	-0.08%
	Upscale	49.73	0.56%	49.65	0.49%	49.69	-0.07%
6	Zero	0.05	-0.20%	0.09	-0.16%	0.07	0.04%
	Upscale	49.65	0.49%	48.82	-0.25%	49.24	-0.74%
7	Zero	0.09	-0.16%	0.06	-0.19%	0.08	-0.03%
	Upscale	48.82	-0.25%	48.83	-0.24%	48.83	0.01%
8	Zero	0.06	-0.19%	0.18	-0.08%	0.12	0.11%
	Upscale	48.83	-0.24%	49.38	0.25%	49.11	0.49%
9	Zero	0.18	-0.08%	0.17	-0.09%	0.18	-0.01%
	Upscale	49.38	0.25%	49.12	0.02%	49.25	-0.23%
10	Zero	0.17	-0.09%	0.17	-0.09%	0.17	0.00%
	Upscale	49.12	0.02%	48.82	-0.25%	48.97	-0.27%

	Cylinder Value	Analyzer Response
Zero	0.00 ppm	0.27 ppm
Upscale	49.60 ppm	49.10 ppm
Span	112.00 ppm	112.00 ppm

** All Drift Calibrations must be within 3% of the span value...

** All Bias Calibrations must be within 5% of the span value...

Calibration Drift

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Test 1L

CO						
		Initial	Pre-Cal Bias	Final	Post-Cal Bias	% Drift of Span
1	Zero	0.06	0.00%	0.17	0.10%	0.12 0.10%
	Upscale	50.67	0.00%	49.98	-0.60%	50.33 -0.60%
2	Zero	0.17	0.10%	0.13	0.06%	0.15 -0.03%
	Upscale	49.98	-0.60%	49.39	-1.11%	49.69 -0.51%
3	Zero	0.13	0.06%	0.15	0.08%	0.14 0.02%
	Upscale	49.39	-1.11%	49.43	-1.08%	49.41 0.03%
4	Zero	0.15	0.08%	0.14	0.07%	0.15 -0.01%
	Upscale	49.43	-1.08%	49.72	-0.83%	49.58 0.25%
5	Zero	0.14	0.07%	0.18	0.10%	0.16 0.03%
	Upscale	49.72	-0.83%	49.86	-0.71%	49.79 0.12%
6	Zero	0.18	0.10%	0.13	0.06%	0.16 -0.04%
	Upscale	49.86	-0.71%	49.86	-0.71%	49.86 0.00%
7	Zero	0.13	0.06%	0.14	0.07%	0.14 0.01%
	Upscale	49.86	-0.71%	49.41	-1.10%	49.64 -0.39%
8	Zero	0.14	0.07%	0.17	0.10%	0.16 0.03%
	Upscale	49.41	-1.10%	50.12	-0.48%	49.77 0.62%
9	Zero	0.17	0.10%	0.13	0.06%	0.15 -0.03%
	Upscale	50.12	-0.48%	49.96	-0.62%	50.04 -0.14%
10	Zero	0.13	0.06%	0.12	0.05%	0.13 -0.01%
	Upscale	49.96	-0.62%	49.98	-0.60%	49.97 0.02%

	Cylinder Value	Analyzer Response	
Zero	0.00 ppm	0.06 ppm	
Upscale	50.80 ppm	50.67 ppm	

Span **114.00 ppm** **114.80 ppm**

** All Drift Calibrations must be within 3% of the span value...

** All Bias Calibrations must be within 5% of the span value...

Interpoll Laboratories
(763) 786-6020

Stationary Gas Turbine Nox Determination
Method 20 NO₂ to NO Converter Efficiency Datasheet

Job	MSI / Manitowoc PU
Source	S20 Boiler Stack
Date	7/23/2013
Operator	Aaron Wilson / Nate Beinemann
Analyzer	TECO Model 42i (NOx)
Analyzer S/N	510511561

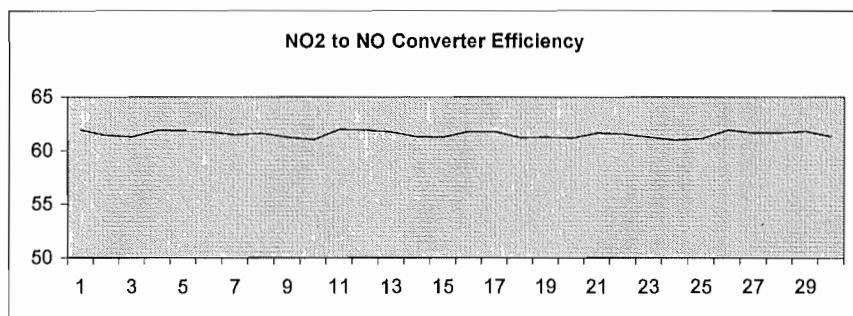
Time (min)	NOx Response
2:13 PM	61.915
2:14 PM	61.457
2:15 PM	61.297
2:16 PM	61.893
2:17 PM	61.866
2:18 PM	61.740
2:19 PM	61.469
2:20 PM	61.617
2:21 PM	61.274
2:22 PM	61.031
2:23 PM	61.989
2:24 PM	61.935
2:25 PM	61.747
2:26 PM	61.307
2:27 PM	61.270
2:28 PM	61.792
2:29 PM	61.770
2:30 PM	61.225
2:31 PM	61.284
2:32 PM	61.192
2:33 PM	61.661
2:34 PM	61.583
2:35 PM	61.286
2:36 PM	61.006
2:37 PM	61.118
2:38 PM	61.929
2:39 PM	61.660
2:40 PM	61.654
2:41 PM	61.808
2:42 PM	61.329

Highest Peak Value 61.99

Percent Drift 1.1%

System Pass of Fail PASS

Instructions: Add mid-level gas to a leak-free Tedlar bag. Dilute the gas with 20.9% Oxygen to approximately 1:1. Then immediately attach the bag to the instrument and record the Nox Reponses for 30 minutes. The system is OK if the response at the end is less than 2.0 % of the highest response.



INTERPOLL LABORATORIES, INC.
(763) 786-6020
EPA Appendix A Stratification Test

Job:	MSI / Manitowoc PU	Date:	7/23/2013
Source:	S20 Boiler Stack	Personnel:	Aaron Wilson / Nate Beinemann
Test	1L	Bar. Press. (in. Hg)	29.04
PDT Number	85 / 138		
Measurement Response Time:	113	seconds	

Stack Diameter		168.00	in.	Port Length	in.	14.00				
Traverse Point	Fraction of Diameter	Distance From Stack Wall (in.)		Distance From End of Port (in.)		Time (min)	SO2 ppm (wet)	Nox ppm (wet)	O2 % (dry)	CO ₂ % (wet)
1	0.17	28.00		42.00		14:50	43.22	21.98	14.87	4.91
2	0.50	84.00		98.00		14:57	43.56	21.47	14.85	4.94
3	0.83	140.00		154.00		15:04	42.31	21.76	14.89	4.76
Average							43.03	21.73	14.87	4.87
							Largest Value	43.56	21.98	14.89
							Smallest Value	42.31	21.47	14.85
							%Deviation	2.96%	2.38%	0.31% 3.76%

* A three point traverse was used for each test run.

MSI / Manitowoc PU
 Manitowoc, WI
 S20 Boiler Stack
 7/23/2013
 Stratification Test Data

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>
14:50:00	44.94	22.02	14.88	5.01
14:51:00	43.99	22.37	14.73	4.92
14:52:00	42.76	21.79	14.80	5.00
14:53:00	42.51	21.89	14.80	4.87
14:54:00	43.42	21.93	14.90	4.88
14:55:00	42.63	21.86	14.98	4.78
14:56:00	42.27	21.99	14.98	4.90
Average	43.22	21.98	14.87	4.91

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>
14:57:00	43.72	22.24	14.84	4.96
14:58:00	43.29	21.89	14.87	4.91
14:59:00	43.39	21.22	14.84	4.91
15:00:00	44.74	22.05	14.87	5.08
15:01:00	43.44	20.97	14.76	4.93
15:02:00	43.12	21.06	14.85	4.90
15:03:00	43.24	20.85	14.91	4.87
Average	43.56	21.47	14.85	4.94

<u>Time</u>	<u>SO₂ ppm, w</u>	<u>Nox ppm, w</u>	<u>%O₂, d</u>	<u>% CO₂, w</u>
15:04:00	43.50	21.40	14.92	4.89
15:05:00	44.63	21.08	14.92	4.95
15:06:00	43.66	21.35	14.92	4.89
15:07:00	40.82	20.74	15.01	4.71
15:08:00	41.18	21.41	15.01	4.91
15:09:00	42.76	21.75	14.91	4.85
15:10:00	39.62	24.56	14.57	4.11
Average	42.31	21.76	14.89	4.76

MSI / Manitowoc PU
Manitowoc, WI
S20 Boiler Stack
7/23/2013
Test 1H

CO₂ (TEI Model 410i)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	% of Span
Zero	0.00	0.03	0.03	16.73	0.18
Mid Level	8.30	8.35	0.05	16.73	0.31
High Level	16.73	16.78	0.05	16.73	0.30

O₂ (Servomex Series 1400)

	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	% of Span
Zero	0.00	0.15	0.15	21.40	0.70
Mid Level	10.70	10.81	0.11	21.40	0.51
High Level	21.40	21.14	0.26	21.40	1.21

**** All Calibrations must be within 2% of the span value...

Calibration Drift

MSI / Manitowoc PU
 Manitowoc, WI
 S20 Boiler Stack
 7/23/2013
 Test 1H

O₂

		Initial	Pre-Cal Bias	Final	Post-cal Bias	Avg.	% Drift of Span
1	Zero	0.15	0.00%	0.10	-0.23%	0.13	-0.23%
	Upscale	10.81	0.00%	10.77	-0.19%	10.79	-0.19%
2	Zero	0.10	-0.23%	0.10	-0.23%	0.10	0.00%
	Upscale	10.77	-0.19%	10.77	-0.19%	10.77	0.00%
3	Zero	0.10	-0.23%	0.10	-0.23%	0.10	0.00%
	Upscale	10.77	-0.19%	10.77	-0.19%	10.77	0.00%
4	Zero	0.10	-0.23%	0.11	-0.19%	0.11	0.05%
	Upscale	10.77	-0.19%	10.78	-0.14%	10.78	0.05%
5	Zero	0.11	-0.19%	0.11	-0.19%	0.11	0.00%
	Upscale	10.78	-0.14%	10.78	-0.14%	10.78	0.00%
6	Zero	0.11	-0.19%	0.11	-0.19%	0.11	0.00%
	Upscale	10.78	-0.14%	10.78	-0.14%	10.78	0.00%
7	Zero	0.11	-0.19%	0.11	-0.19%	0.11	0.00%
	Upscale	10.78	-0.14%	10.78	-0.14%	10.78	0.00%
8	Zero	0.11	-0.19%	0.11	-0.19%	0.11	0.00%
	Upscale	10.78	-0.14%	10.78	-0.14%	10.78	0.00%
9	Zero	0.11	-0.19%	0.11	-0.19%	0.11	0.00%
	Upscale	10.78	-0.14%	10.78	-0.14%	10.78	0.00%
10	Zero	0.11	-0.19%	0.11	-0.19%	0.11	0.00%
	Upscale	10.78	-0.14%	10.78	-0.14%	10.78	0.00%

	Cylinder Value	Analyzer Value
Zero	0.00 %	0.15 %
Upscale	10.70 %	10.81 %
Span	21.40 %	21.4 %

** All Drift Calibrations must be within 3% of the span value...

** All Bias Calibrations must be within 5% of the span value...

Calibration Drift

MSI / Manitowoc PU
 Manitowoc, WI
 S20 Boiler Stack
 7/23/2013
 Test 1H

CO ₂						
		Initial	Pre-Cal Bias	Final	Post-Cal Bias	% Drift of Span
1	Zero	0.03	0.00%	0.06	0.18%	0.05 0.18%
	Upscale	8.35	0.00%	8.40	0.29%	8.38 0.29%
2	Zero	0.06	0.18%	0.06	0.18%	0.06 0.00%
	Upscale	8.40	0.29%	8.40	0.29%	8.40 0.00%
3	Zero	0.06	0.18%	0.06	0.18%	0.06 0.00%
	Upscale	8.40	0.29%	8.40	0.29%	8.40 0.00%
4	Zero	0.06	0.18%	0.05	0.12%	0.06 -0.06%
	Upscale	8.40	0.29%	8.35	-0.01%	8.38 -0.30%
5	Zero	0.05	0.12%	0.05	0.12%	0.05 0.00%
	Upscale	8.35	-0.01%	8.35	-0.01%	8.35 0.00%
6	Zero	0.05	0.12%	0.05	0.12%	0.05 0.00%
	Upscale	8.35	-0.01%	8.35	-0.01%	8.35 0.00%
7	Zero	0.05	0.12%	0.05	0.12%	0.05 0.00%
	Upscale	8.35	-0.01%	8.35	-0.01%	8.35 0.00%
8	Zero	0.05	0.12%	0.05	0.12%	0.05 0.00%
	Upscale	8.35	-0.01%	8.35	-0.01%	8.35 0.00%
9	Zero	0.05	0.12%	0.05	0.12%	0.05 0.00%
	Upscale	8.35	-0.01%	8.35	-0.01%	8.35 0.00%
10	Zero	0.05	0.12%	0.05	0.12%	0.05 0.00%
	Upscale	8.35	-0.01%	8.35	-0.01%	8.35 0.00%

	Cylinder Value	Analyzer Response
Zero	0.00 ppm	0.03 ppm
Upscale	8.30 ppm	8.35 ppm
Span	16.73 ppm	16.73 ppm

** All Drift Calibrations must be within 3% of the span value...
 ** All Bias Calibrations must be within 5% of the span value...

APPENDIX E

CALIBRATION GAS CERTIFICATION SHEETS

THE LINDE GROUP

**CERTIFICATE OF ANALYSIS****EPA PROTOCOL MIXTURE****PROCEDURE # : G1**

PGVP ID#: I12012
CUSTOMER: HAMMOND
SALES#: 501172279
PROD#: 1240925
P.O.# : 4501172279
MATERIAL#: 24090596
CERTIFICATION DATE: 18-Dec-2012
EXPIRATION DATE: 19-Dec-2020
 (Using the May 2012 Revision of the EPA Protocol)

GAS CODE: OC2
CYLINDER #: CC-131002
CYLINDER PRES: 2000 PSIG
CYLINDER VALVE: CGA 590
CYLINDER SIZE: 2A
CYLINDER MATERIAL: Aluminum
GAS VOLUME: 4000 Liter
BLEND TOLERANCE: 5% Relative
PAGE: 1 of 1

CERTIFICATION HISTORY

COMPONENT	DATE OF ASSAY	MEAN CONCENTRATION	CERTIFIED CONCENTRATION	ANALYTICAL ACCURACY
Carbon Dioxide	18-Dec-2012	16.73 %	16.73 %	+/- 1%
Oxygen	18-Dec-2012	21.4 %	21.4 %	+/- 1%

BALANCE Nitrogen

PREVIOUS CERTIFICATION DATES: None

REFERENCE STANDARDS

COMPONENT	SRM/NTRM#	CYLINDER#	CONCENTRATION
Carbon Dioxide	NTRM-82745x	SG-9609736	19.98 %
Oxygen	NTRM-82659Y	cc-237244	24.52 %

INSTRUMENTATION

COMPONENT	MAKE/MODEL	SERIAL #	DETECTOR	CALIBRATION DATE(S)
Carbon Dioxide	CAI-300	S03001	NDIR	14-Dec-2012
Oxygen	CAI-300	S03001	PM	21-Nov-2012

THIS STANDARD IS NIST TRACEABLE. IT WAS CERTIFIED ACCORDING TO THE 1997 EPA PROTOCOL PROCEDURES.
DO NOT USE THIS STANDARD IF THE CYLINDER PRESSURE IS LESS THAN 100 PSIG.

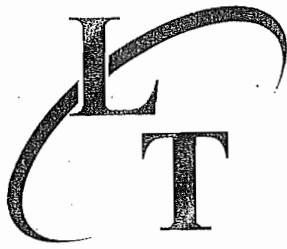
ANALYST:

MATTHEW JACKSON

Linde Gas North America LLC

DATE: 18-Dec-2012

(908) 329-9700 Main (908) 329-9740 Fax
www.Lindeus.com



LIQUID TECHNOLOGY CORPORATION
"INDUSTRY LEADER IN SPECIALTY GASES"

Certificate of Analysis
- EPA PROTOCOL GAS -

Customer Minneapolis Oxygen (Minneapolis, MN)

Date June 18, 2013

Delivery Receipt DR-47332

Gas Standard 8.50% CO₂, 11.0% Oxygen/Nitrogen - EPA PROTOCOL

Part Number: SPC NAE 03075

Final Analysis Date June 17, 2013

Expiration Date June 17, 2021

DO NOT USE BELOW 100 psig

Cylinder Data

Cylinder Serial Number: EB-0019925

Cylinder Outlet: CGA 590

Cylinder Volume: 136 Cubic Feet

Cylinder Pressure: 1950 psig, 70°F

Expiration Date: June 17, 2021

Analytical Data

EPA Protocol, Section No. 2.2, Procedure G-1

Replicate Concentrations

Carbon Dioxide: 8.30% +/- 0.07%

Oxygen: 10.7% +/- 0.08%

Nitrogen: Balance

Reference Standard(s):

GMIS/SRM:	GMIS/GMIS	GMIS
Cylinder Number:	EB-0026839/CC-185129	CC-231332
Concentration:	6.847% CO ₂ /13.92% CO ₂	9.97% Oxygen
Expiration Date:	10/13/20 - 06/24/14	04/06/14

Certification Instrumentation

Component:	Carbon Dioxide	Oxygen
Make/Model:	Nicolet 6700	Servomex 244a
Serial Number:	APW1200289	1847
Principal of Measurement:	FTIR	Paramagnetic
Last Calibration:	May 23, 2013	May 31, 2013

Analytical uncertainty and NIST Traceability are in compliance with EPA-600/R-12/531.

Certified by:

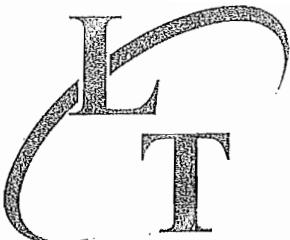
David Scott

PGVP Vendor ID: E12013

"UNMATCHED EXCELLENCE"

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MPU01629



LIQUID TECHNOLOGY CORPORATION

"INDUSTRY LEADER IN SPECIALTY GASES"

Certificate of Analysis - EPA PROTOCOL GAS -

Customer
Date
Delivery Receipt
Gas Standard
Final Analysis Date
Expiration Date
Part Number

Minneapolis Oxygen (Minneapolis, MN)
May 13, 2013
DR-46947
112.5 ppm CO, 112.5 ppm NO, 112.5 ppm SO₂/Nitrogen - EPA PROTOCOL
May 13, 2013
May 13, 2021
SPC NAE04050

DO NOT USE BELOW 100 psig

Analytical Data:

EPA Protocol, Section No. 2.2, Procedure G-1.

Reported Concentrations

Carbon Monoxide: 114 ppm +/- 0.64 ppm

Nitric Oxide: 113 ppm +/- 0.40 ppm

Sulfur Dioxide: 112 ppm +/- 0.86 ppm

Nitrogen: Balance

Total NOx: 113 ppm

**** NOx for Reference Use Only ****

Reference Standards

SRM/GMIS:	GMIS	GMIS/GMIS	GMIS/GMIS
Cylinder Number:	EB-0015851	ND-45693/ND-45515	EB-0014653/CC-251490
Concentration:	104.90 ppm CO	97.434 ppm/245.26 ppm NO	103.89 ppm SO ₂ /507.877 ppm SO ₂
Expiration Date:	10/21/13	08/23/15 - 10/22/14	12/01/14 - 04/12/15

Certification Instrumentation

Component:	Carbon Monoxide	Nitric Oxide	Sulfur Dioxide
Make/Model:	NEXUS 6700	NEXUS 6700	NEXUS 6700
Serial Number:	APW1200289	APW1200289	APW1200289
Principal of Measurement:	FTIR	FTIR	FTIR
Last Calibration:	April 24, 2013	April 24, 2013	April 24, 2013

Cylinder Data

Cylinder Number:	EB-0040597	Cylinder Volume:	136 Cubic Feet
Cylinder Outlet:	CGA 660	Cylinder Pressure:	1950 psig, 70°F
Expiration Date:	May 13, 2021		

Analytical Uncertainty and NIST Traceability are in compliance with EPA-600/R-12/531.

Certified by:

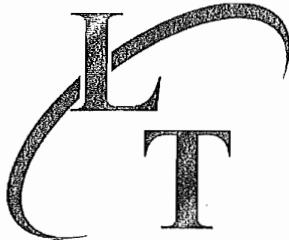
David Scott

PGVP Vendor ID: E12013

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MPU01630



LIQUID TECHNOLOGY CORPORATION
"INDUSTRY LEADER IN SPECIALTY GASES"

Certificate of Analysis
- EPA PROTOCOL GAS -

Customer
Date
Delivery Receipt
Gas Standard
Final Analysis Date
Expiration Date

Minneapolis Oxygen (Minneapolis, MN)
February 19, 2013
DR-45794
50.0 ppm CO, 50.0 ppm NO, 50.0 ppm SO₂/Nitrogen - EPA PROTOCOL
February 11, 2013
February 11, 2021

DO NOT USE BELOW 150 psig

Analytical Data:

EPA Protocol, Section No. 2.2, Procedure G-1.

Reported Concentrations

Carbon Monoxide: 50.8 ppm +/- 0.29 ppm

Nitric Oxide: 50.4 ppm +/- 0.27 ppm

Sulfur Dioxide: 49.6 ppm +/- 0.49 ppm

Nitrogen: Balance

Total NO_x: 50.5 ppm

**** NO_x for Reference Use Only ****

Reference Standards

SRM/GMIS:	GMIS	GMIS	GMIS
Cylinder Number:	CC-128982	CC-88803	EB-0014698
Concentration:	50.89 ppm CO	49.52 ppm NO	50.67 ppm SO ₂
Expiration Date:	10/20/14	07/18/13	09/20/14

Certification Instrumentation

Component:	Carbon Monoxide	Nitric Oxide	Sulfur Dioxide
Make/Model:	NEXUS 6700	NEXUS 6700	NEXUS 6700
Serial Number:	AEP99000154	AEP99000154	AEP99000154
Principal of Measurement:	FTIR	FTIR	FTIR
Last Calibration:	January 30, 2013	January 30, 2013	January 30, 2013

Cylinder Data

Cylinder Number:	CC-115901	Cylinder Volume:	133 Cubic Feet
Cylinder Outlet:	CGA 660	Cylinder Pressure:	1900 psig, 70°F
Expiration Date:	February 11, 2021		

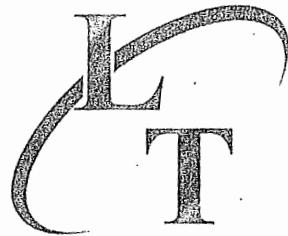
Analytical Uncertainty and NIST Traceability are in compliance with EPA-600/R-12/531.

Certified by:

David Scott

PGVP Vendor ID: E12013

"UNMATCHED EXCELLENCE"



LIQUID TECHNOLOGY CORPORATION
"INDUSTRY LEADER IN SPECIALTY GASES"

Certificate of Analysis
- EPA PROTOCOL GAS -

Customer Minneapolis Oxygen (Minneapolis, MN)
Date April 29, 2013
Delivery Receipt DR-46677
Gas Standard 250 ppm CO, 250 ppm NO, 250 ppm SO₂/Nitrogen - EPA PROTOCOL
Final Analysis Date April 01, 2013
Expiration Date April 01, 2021

DO NOT USE BELOW 100 psig

Analytical Data:

EPA Protocol, Section No. 2.2, Procedure G-1.

Reported Concentrations

Carbon Monoxide: 254 ppm +/- 1.0 ppm
Nitric Oxide: 249 ppm +/- 0.41 ppm
Sulfur Dioxide: 255 ppm +/- 1.0 ppm
Nitrogen: Balance
Total NOx: 249 ppm

**** NOx for Reference Use Only ****

Reference Standards

SRM/GMIS:	GMIS	GMIS/GMIS	GMIS/GMIS
Cylinder Number:	CC-185111	ND-45693/ND-45515	EB-0014653/CC-251490
Concentration:	257.469 ppm CO	97.434 ppm/245.26 ppm NO	103.89 ppm SO ₂ /507.877 ppm SO ₂
Expiration Date:	10/22/14	08/23/15 - 10/22/14	12/01/14 - 04/12/15

Certification Instrumentation

Component:	Carbon Monoxide	Nitric Oxide	Sulfur Dioxide
Make/Model:	NEXUS 6700	NEXUS 6700	NEXUS 6700
Serial Number:	APW1200289	APW1200289	APW1200289
Principal of Measurement:	FTIR	FTIR	FTIR
Last Calibration:	March 28, 2013	March 28, 2013	March 28, 2013

Cylinder Data

Cylinder Number:	EB-0033979	Cylinder Volume:	135 Cubic Feet
Cylinder Outlet:	CGA 660	Cylinder Pressure:	1925 psig, 70°F
Expiration Date:	April 01, 2021		

Analytical Uncertainty and NIST Traceability are in compliance with EPA-600/R-12/531.

Certified by:

David Scott

PGVP Vendor ID: E1

"UNMATCHED EXCELLENCE"

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APPENDIX F

GAS ANALYZER SPECIFICATIONS

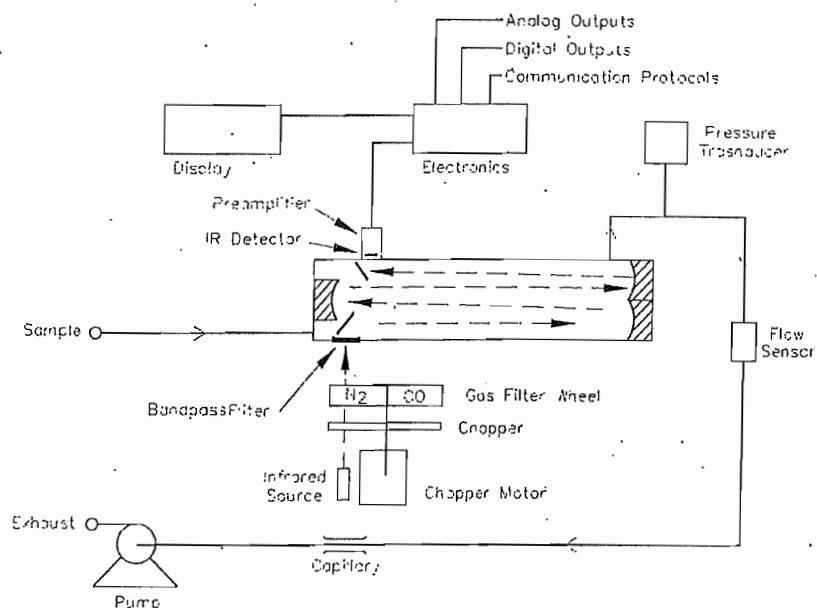


Figure 1-1. Model 48*i* Flow Schematic

Specifications

Table 1-1. Model 48*i* Specifications

Preset ranges	0-1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000 (ppm or mg/m ³)
Custom ranges	0-1 to 10000 (ppm or mg/m ³)
Zero noise	0.02 ppm RMS (30 second averaging time)
Lower detectable limit	0.04 ppm
Zero drift (24 hour)	< 0.1 ppm
Span drift	± 1% full-scale
Response time	60 seconds (30 second averaging time)
Linearity	± 1% of full-scale ≤ 1000 ppm ± 2.5% of full-scale > 1000 ppm
Sample flow rate	1.0 LPM
Operating temperature	20–30 °C (may be safely operated over the range of 0–45 °C)

Introduction
Specifications

Power requirements	100 VAC @ 50/60 Hz 115 VAC @ 50/60 Hz 220–240 VAC @ 50/60 Hz 275 watts
Physical dimensions	16.75" (W) X 8.62" (H) X 23" (D)
Weight	Approximately 49 lbs.
Analog outputs	6 voltage outputs; 0–100 mV, 1, 5, 10 V (User selectable), 5% of full-scale over/under range, 12 bit resolution, user selectable for measurement input
Digital outputs	1 power fail relay Form C, 10 digital relays Form A, user selectable alarm output, relay logic, 100 mA @ 200 VDC
Digital inputs	16 digital inputs, user select programmable, TTL level, pulled high
Serial Ports	1 RS-232 or RS-485 with two connectors, baud rate 1200–115200, data bits, parity, and stop bits, protocols: C-Link, MODBUS, and streaming data (all user selectable)
Ethernet connection	RJ45 connector for 10Mbs Ethernet connection, static or dynamic TCP/IP addressing

*In non condensing environments. Performance specifications based on operation with 20–30 °C range.

MODEL 1420 SERVOMEX PARAMAGNETIC O₂ ANALYZER SPECIFICATIONS

Repeatability:	Better than ± 0.2% O ₂ under constant conditions
Drift	Less than 0.2% O ₂ per week under constant conditions. (Excluding variation due to barometric pressure changes; reading is proportional to barometric pressure)
Outputs	
Display	3 ½ digit LCD reading 0.0 to 100.0% oxygen with over range capability
Output	0 to 1V (non-isolated) for 0 to 100% oxygen available on 'D' type connector located on the back panel of the instrument. Output impedance is less than 10 ohms.
Option	4 – 20mA isolated, Max impedance 500 ohms
Flow alarm output	Change over relay contact rated at 3A/115V ac, 1A/240V ac or 1A/28V dc. 4 sets of single pole changeover contacts. Alarm becomes active when sample gas flow through the analyzer fails
Sample Requirements	
Condition	Clean, dry gas with dew point 5 deg C below ambient temperature
Inlet pressure	0.5 to 3 psig (3.5 to 21kPa). Inlet pressure changes within this range will change the reading by less than 0.1% O ₂ . May be operated up to 10 psig (70kPa) with degraded stability
Flow rate	1.5 to 6 litres/minute approximately depending on sample pressure
Filtering	0.6 micron replaceable filter integral to the automatic flow control device.
Response time	Less than 15 secs. To 90% at an inlet pressure of 3 psig (21kPa)
Inlet/vent connections	¼ inch OD tube (stainless steel) suitable for 6mm ID flexible tubing or ¼ inch OD compression fittings.

Materials exposed to the sample	Stainless steel, Pyrex glass, brass, platinum, epoxy resin, viton, polypropylene and glass fibre filter
<u>Physical Characteristics</u>	
Case	Steel and aluminum finished in epoxy powder paint
Case Classification	IP 20 (IEC 529) when fitted into the Servomex 1400 series 19 inch case
Weight	10Kg (22 lb) approximately
<u>Electrical</u>	
AC Supply	110 to 120V AC or 220 to 240V AC, $\pm 10\%$, 48 to 62Hz. Voltage selected by a voltage selector integral to the IEC supply plug
Power required	15VA maximum

NO_2 , and NO_x concentrations to the front panel display, the analog outputs, and also makes the data available over the serial or ethernet connection.

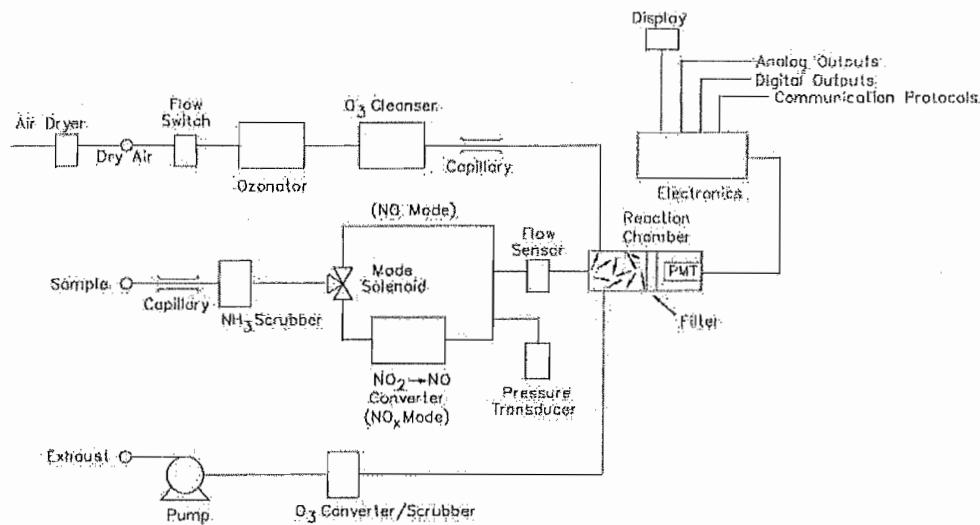


Figure 1-1. Model 42i Low Source Flow Schematic

Specifications

Table 1-1. Model 42i Low Source Specifications

Preset ranges	0-0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 ppm 0-0.5, 1, 2, 5, 10, 20, 50, 100, 150 mg/m ³
Extended ranges	0-1, 2, 5, 10, 20, 50, 100, 200, 500 ppm 0-2, 5, 10, 20, 50, 100, 200, 500, 750 mg/m ³
Custom ranges	0-0.2 to 100 ppm (0-1 to 500 ppm in extended ranges) 0-0.5 to 150 mg/m ³ (0-2 to 750 mg/m ³ in extended ranges)
Zero noise	0.005 ppm RMS (60 second averaging time)
Lower detectable limit	0.01 ppm (60 second averaging time)
Zero drift (24 hour)	≈ 0.005 ppm
Span drift (24 hour)	± 1% full-scale
Response time (NO/NO _x mode)	15 sec (10 second averaging time) 85 sec (60 second averaging time) 305 sec (300 second averaging time)

Introduction
Specifications

Response time (NO mode)	15 sec (10 second averaging time) 65 sec (60 second averaging time) 305 sec (300 second averaging time)
Linearity	± 1% full-scale
Sample flow rate	≈ 25 cc/min. measured at atmospheric pressure
Operating temperature	15–35 °C (may be safely operated over the range of 0–45 °C) ¹
Power requirements	100 VAC @ 50/60 Hz 115 VAC @ 50/60 Hz 220–240 VAC @ 50/60 Hz 300 watts
Physical dimensions	16.75" (W) X 8.62" (H) X 23" (D)
Weight	Approximately 55 lbs.
Analog outputs	6 voltage outputs; 0–100 mV, 1 V, 5 V, 10 V (User selectable); 5% of full-scale over/under range, 12 bit resolution, user selectable for measurement input
Digital outputs	1 power fail relay Form C, 10 digital relays Form A, user selectable alarm output, relay logic, 100 mA @ 200 VDC
Digital inputs	16 digital inputs, user select programmable, TTL level, pulled high
Serial Ports	1 RS-232 or RS-485 with two connectors, baud rate 1200–115200, data bits, parity, and stop bits, protocols: C-Link, MODBUS, and streaming data (all user selectable)
Ethernet connection	RJ45 connector for 10Mbps Ethernet connection, static or dynamic TCP/IP addressing

¹In non condensing environments. Performance specifications based on operation in 15–35 °C range.

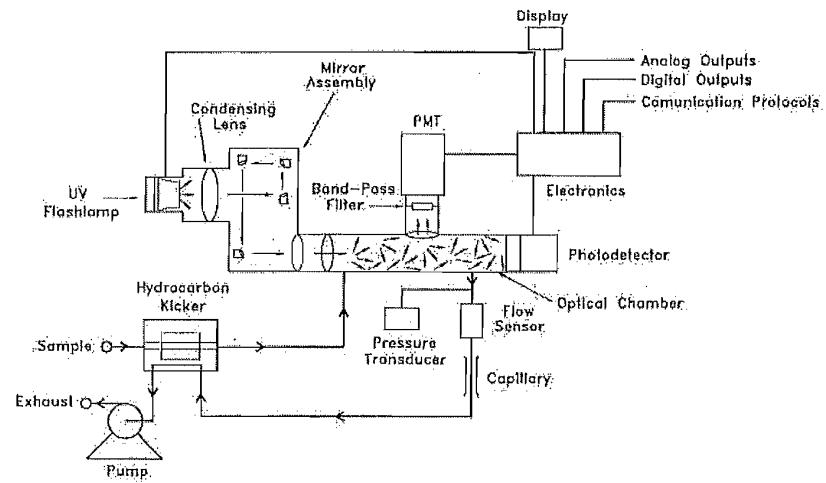


Figure 1-1. Model 43*i* Flow Schematic

Specifications

Table 1-1. Model 43*i* Specifications

Preset ranges	0-0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 ppm 0-0.2, 0.5, 1, 2, 5, 10, 20, 25 mg/m ³
Extended ranges	0-0.5, 1, 2, 5, 10, 20, 50, 100 ppm 0-2, 5, 10, 20, 50, 100, 200, 250 mg/m ³
Custom ranges	0-0.05 to 10 ppm (0-0.5 to 100 ppm in extended range) 0-0.2 to 25 mg/m ³ (0-2 to 250 mg/m ³ in extended range)
Zero noise	1.0 ppb RMS (10 second averaging time) 0.5 ppb RMS (60 second averaging time) 0.25 ppb RMS (300 second averaging time)
Lower detectable limit	2.0 ppb (10 second averaging time) 1.0 ppb (60 second averaging time) 0.5 ppb (300 second averaging time)
Zero drift (24 hour)	<1 ppb
Span drift	± 1% full-scale
Response time (in automatic mode)	80 sec (10 second averaging time) 110 sec (60 second averaging time) 320 sec (300 second averaging time)
Linearity	± 1% of full-scale

Sample flow rate	0.5 LPM (standard) 1 LPM (optional)
Interferences (tested at levels specified by EPA)	less than lower detectable limit except for the following: NO: <3 ppb, tested at 500 ppb; M-Xylene: tested at 200 ppb H ₂ O; tested at 2% of reading
Operating temperature	20–30 °C (may be safely operated over the range of 0–45 °C)*
Power requirements	100 VAC @ 50/60 Hz 115 VAC @ 50/60 Hz 220–240 VAC @ 50/60 Hz 165 watts
Physical dimensions	16.75" (W) X 8.62" (H) X 23" (D)
Weight	Approximately 48 lbs.
Analog outputs	6 voltage outputs; 0–100 mV, 1, 5, 10 V (user selectable), 5% of full-scale over/under range, 12 bit resolution, user selectable for measurement input
Digital outputs	1 power fail relay Form C, 10 digital relays Form A, user selectable alarm output, relay logic, 100 mA @ 200 VDC
Digital inputs	16 digital inputs, user select programmable, TTL level, pulled high
Serial Ports	1 RS-232 or RS-485 with two connectors, baud rate 1200–115200, data bits, parity, and stop bits, protocols: C-Link, MODBUS, and streaming data (all user selectable)
Ethernet connection	RJ45 connector for 10Mbps Ethernet connection, static or dynamic TCP/IP addressing

*In non condensing environments. Performance specifications based on operation within 20–30 °C range.

Table 1-2. Model 43*i* Optional Permeation Oven Specifications

Temperature control	Single Point 45 °C
Temperature stability	± 0.1 °C
Warm-up time	1 hour (permeation device can take 24 to 48 hours to stabilize)
Carrier gas flow	≈ 70 scc/min
Chamber size	Accepts permeation tubes up to 9 cm in total length; 1 cm in diameter
Temperature range	20–30 °C
Physical dimensions	Contained inside the Model 43 <i>i</i>
Power requirements	120 VAC @ 50/60 Hz, 50 watts (in addition to the standard Model 43 <i>i</i>)
Weight	Approximately 5 lbs. (in addition to the standard Model 43 <i>i</i>)

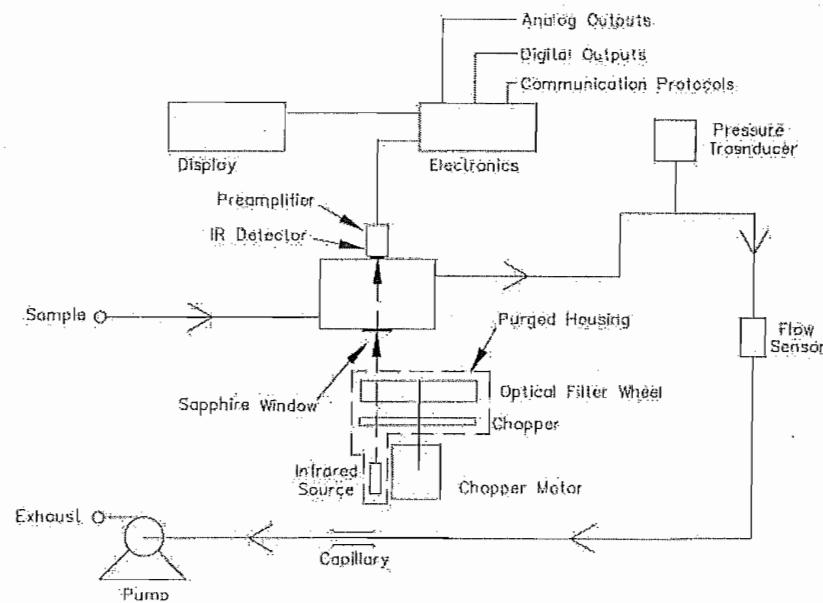


Figure 1-1. Model 410i Flow Schematic

Specifications

Table 1-1. Model 410i Specifications

CO_2	
Preset ranges	Standard: 0-200, 500, 1000, 2000, 5000, 10000 ppm High Level: 0-0.5, 1, 2, 5, 10, 20, 25%
Custom ranges	Standard: 0-200 to 10000 ppm High Level: 0-0.5 to 25%
Zero noise	Standard: 0.5 ppm RMS (60 second averaging time) High Level: 20 ppm RMS (60 second averaging time)
Minimum detectable limit	Standard: 1 ppm High Level: 40 ppm
Zero drift (24 hour)	$\pm 1.0 \text{ ppm}$
Span drift (24 hour)	$\pm 2\%$ span concentration
Response time	90 seconds (30 second averaging time)
Linearity	$\pm 1.5\%$ of span (at concentrations of 10 to 100% of span)
Sample flow rate	1.0 LPM
Operating temperature	5-45 °C

Introduction
Specifications

Power requirements	100 VAC @ 50/60 Hz 115 VAC @ 50/60 Hz 220–240 VAC @ 50/60 Hz 275 watts.
Physical dimensions	16.75" (W) X 8.62" (H) X 23" (D)
Weight	Approximately 39 lbs.
Analog outputs	6 voltage outputs; 0–100 mV, 1, 5, 10 V (User selectable), 5% of full-scale over/under range, 12 bit resolution, user selectable for measurement input
Digital outputs	1 power fail relay Form C, 10 digital relays Form A, user selectable alarm output, relay logic, 100 mA @ 200 VDC
Digital inputs	16 digital inputs, user select programmable, TTL level, pulled high
Serial Ports	1 RS-232 or RS-485 with two connectors, baud rate 1200–115200, Protocols: C-Link, MODBUS, and streaming data (all user selectable)
Ethernet connection	RJ45 connector for 10Mbps Ethernet connection, static or dynamic TCP/IP addressing

APPENDIX G

CEM INSTRUMENT INFORMATION SHEETS

INTERPOL LABORATORIES, INC.
(763) 786-6020

CEM Relative Accuracy Certification Instrument Information Sheet

Plant Name:	Manitowoc Public Utilities			Plant Location:	Manitowoc, WI		
Pollutant Gas Monitor Data:				Diluent Monitor Data:			
Vendor:	Thermo			Vendor:	Thermo		
Model:	436 S20 Stack			Model:	410 / S20 Stack		
Location:	<input checked="" type="checkbox"/> SO ₂	<input type="checkbox"/> NOx	<input type="checkbox"/> CO	Location:	<input type="checkbox"/> O ₂	<input type="checkbox"/> CO ₂	
Gas (es):	<input type="checkbox"/> In-Situ	<input type="checkbox"/> Extractive	<input checked="" type="checkbox"/> Dilution	Gas:	<input checked="" type="checkbox"/> In-Situ	<input type="checkbox"/> Extractive	
Type of System:				Type of System:			
Installation Date:	10 Sept. 09			Installation Date:	08 Sept. 08		
Start-Up Date:	10 Sept. 09			Start-Up Date:	08 Sept. 08		
Data Recording System:				Data Recording System:			
<input type="checkbox"/> Strip Chart Recorder	<input checked="" type="checkbox"/> Data Logger System			<input type="checkbox"/> Strip Chart Recorder	<input checked="" type="checkbox"/> Data Logger System		
<input checked="" type="checkbox"/> Computer				<input checked="" type="checkbox"/> Computer			
Relative Accuracy Certification Units:				Output Units:			
<input type="checkbox"/> ppm, dry	<input type="checkbox"/> LB/10 ⁶ BTU by O ₂ F-Factor			<input type="checkbox"/> %O ₂ , dry	<input type="checkbox"/> %CO ₂ , dry		
<input checked="" type="checkbox"/> ppm, wet	<input type="checkbox"/> LB/10 ⁶ BTU by CO ₂ F-Factor			<input type="checkbox"/> %O ₂ , wet	<input checked="" type="checkbox"/> %CO ₂ , wet		
				<input type="checkbox"/> LBS/HR			
Span Value (ppm):				Span Gas Values (% v/v):			
SO ₂	0 - 1200			Low	***Carbon Dioxide***		
NOx	0 - 500			High	5.15		
CO					17.21		
				<i>James Jani</i>			Date
				<i>James Jani</i>			<i>9-18-09</i>
							Signature of Person Responsible for Data

INTERPOLL LABORATORIES, INC.
(763) 786-6020

CEM Relative Accuracy Certification Instrument Information Sheet

Plant Name:	Manitowoc Public Utilities		Plant Location:	Manitowoc, WI	
Pollutant Gas Monitor Data:			Diluent Monitor Data:		
Vendor:	Thermo		Vendor:	Thermo	
Model:	<u>421-D</u>	S/N <u>0908635558</u>	Model:	<u>4101</u>	S/N <u>081429266</u>
Location:	<input type="checkbox"/> SO ₂	<input checked="" type="checkbox"/> Stack	Location:	<input type="checkbox"/> O ₂	<input checked="" type="checkbox"/> Stack
Gas (es):	<input type="checkbox"/> In-Situ	<input type="checkbox"/> NOx	Gas:	<input type="checkbox"/> In-Situ	<input checked="" type="checkbox"/> CO ₂
Type of System:	<input type="checkbox"/> Extractive	<input checked="" type="checkbox"/> Dilution	Type of System:	<input checked="" type="checkbox"/> Extractive	<input type="checkbox"/> Extractive
Installation Date:	<u>10 Sept. 09</u>		Installation Date:	<u>08 Sept. 09</u>	
Start-Up Date:	<u>10 Sept. 09</u>		Start-Up Date:	<u>08 Sept. 09</u>	
Data Recording System:			Data Recording System:		
<input type="checkbox"/> Strip Chart Recorder	<input checked="" type="checkbox"/> Data Logger System	<input type="checkbox"/> Computer	<input type="checkbox"/> Strip Chart Recorder	<input checked="" type="checkbox"/> Data Logger System	<input type="checkbox"/> Computer
Relative Accuracy Certification Units:			Output Units:		
<input type="checkbox"/> ppm, dry	<input type="checkbox"/> LB/10 ⁶ BTU by O ₂ F-Factor	<input type="checkbox"/> %O ₂ , dry	<input type="checkbox"/> ppm, wet	<input type="checkbox"/> LB/10 ⁶ BTU by CO ₂ F-Factor	<input checked="" type="checkbox"/> %CO ₂ , wet
<input checked="" type="checkbox"/> ppm, wet	<input checked="" type="checkbox"/> LB/10 ⁶ BTU by CO ₂ F-Factor	<input type="checkbox"/> %O ₂ , wet	<input type="checkbox"/> BS/HR	<input type="checkbox"/> BS/HR	
Span Value (ppm):			Span Gas Values (% v/v):		
SO ₂	<u>0 - 1200</u>		*****Oxygen*****	<u>***Carbon Dioxide***</u>	
NOx	<u>0 - 500</u>		J.F.	<u>5.15</u>	<u>17.21</u>
CO			Low		
			High		
<i>[Signature]</i>			<i>[Signature]</i>		
Date			Date		

Signature of Person Responsible for Data

INTERPOLL LABORATORIES, INC.
(763) 786-6020

CEM Relative Accuracy Certification Instrument Information Sheet

Plant Name:	Minneapolis Public Utilities		Plant Location:
Pollutant Gas Monitor Data:			
Vendor:	Theerao Environmental		Vendor:
Model:	48;	S/N	48CM08270019
Location:	SO ₂ stack		Model:
Gas (es):	<input type="checkbox"/> SO ₂	<input type="checkbox"/> NOx	<input checked="" type="checkbox"/> CO
Type of System:	<input type="checkbox"/> In-Situ	<input type="checkbox"/> Extractive	<input checked="" type="checkbox"/> Dilution
Probe Manufacturer:	EPA		Installation Date:
Installation Date:	16 Aug 2012		Start-Up Date:
Start-Up Date:	16 Aug 2012		
Data Recording System:			
<input checked="" type="checkbox"/> Data Logger System			
<input type="checkbox"/> Strip Chart Recorder			
<input type="checkbox"/> Computer			
Relative Accuracy Certification Units:			
<input type="checkbox"/> ppm, dry			
<input checked="" type="checkbox"/> ppm, wet			
Span Value (ppm):			
SO ₂			*****Oxygen *****
NOx			***Carbon Dioxide***
CO	100 / 5000		
Signature of Person Responsible for Data			
Date			

APPENDIX H

CEM DATA

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 14:50 Through 07/23/2013 15:10
Time Online Criteria: 1 minute(s)

~~Bauer 8 Gas~~
Run #1

Source

Parameter Unit(	S20					S20SO2FM (LB/MMBTU)		S20STEAM (KLBS/HR)	
	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFFACT (MMBTU/CF)	S20NOX#M (LB/MMBTU)	S20PCO (PPM)	S20SO2FM (LB/MMBTU)	S20STEAM (KLBS/HR)
07/23/13 14:50	0.108	5.0	22.1	44.4	1,877.0	0.099	39.7	0.277	77
07/23/13 14:51	0.107	5.1	22.1	44.9	1,877.0	0.097	39.6	0.274	85
07/23/13 14:52	0.108	5.0	22.5	43.2	1,877.0	0.101	39.6	0.269	78
07/23/13 14:53	0.107	5.0	22.2	42.8	1,877.0	0.100	39.3	0.267	78
07/23/13 14:54	0.108	5.0	22.4	43.3	1,877.0	0.100	39.4	0.270	85
07/23/13 14:55	0.109	5.0	22.7	43.8	1,877.0	0.102	39.8	0.273	76
07/23/13 14:56	0.113	5.0	22.7	43.0	1,877.0	0.102	41.4	0.268	82
07/23/13 14:57	0.111	5.0	22.5	42.9	1,877.0	0.101	40.8	0.267	83
07/23/13 14:58	0.111	5.0	22.5	43.4	1,877.0	0.101	40.7	0.270	77
07/23/13 14:59	0.109	5.1	22.2	42.4	1,877.0	0.098	40.3	0.259	85
07/23/13 15:00	0.107	5.0	21.7	43.1	1,877.0	0.097	39.1	0.269	83
07/23/13 15:01	0.106	5.0	21.9	42.1	1,877.0	0.098	38.9	0.262	76
07/23/13 15:02	0.105	5.1	21.5	41.8	1,877.0	0.094	39.0	0.255	84
07/23/13 15:03	0.103	5.0	21.5	41.3	1,877.0	0.096	37.8	0.257	81
07/23/13 15:04	0.104	5.0	21.6	41.4	1,877.0	0.097	38.2	0.258	77
07/23/13 15:05	0.105	5.0	21.5	41.5	1,877.0	0.096	38.5	0.259	85
07/23/13 15:06	0.101	5.0	21.6	41.6	1,877.0	0.097	37.0	0.259	79
07/23/13 15:07	0.101	5.0	21.9	40.8	1,877.0	0.098	37.2	0.254	77
07/23/13 15:08	0.104	5.0	21.7	38.8	1,877.0	0.097	38.0	0.242	85
07/23/13 15:09	0.102	5.0	21.9	40.0	1,877.0	0.098	37.3	0.249	77
07/23/13 15:10	0.106	5.0	22.0	40.2	1,877.0	0.099	38.7	0.251	80
 Average									
Average	0.106	5.0	22.0	42.2	1,877.0	0.098	39.1	0.262	80
Minimum	0.101	5.0	21.5	38.8	1,877.0	0.094	37.0	0.242	76
Maximum	0.113	5.1	22.7	44.9	1,877.0	0.102	41.4	0.277	85
Summation	2.235	105.3	462.7	886.7	39,417.0	2.068	820.3	5.509	1,690
Included Data Points	21	21	21	21	21	21	21	21	21
Total number of Data Points									

Average
Minimum
Maximum
Summation
Included Data Points
Total number of Data Points

F = Unit Offline E = Exceedance
M = Maintenance T = Out Of Control
C = Calibration S = Substituted
 * = Suspect U = Startup
 Report Generated: 07/23/13 15:11 D = Shutdown
 Report Version 3.1.1130

S = Standard
= New
= Revived
= Reverted
= Suspended
= Shutdown
= Startup
= Calibration
= Substituted
= Suspect

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 15:20 Through 07/23/2013 15:40

Time Online Criteria: 1 minute(s)

Source	S20						S20SO2#M (LB/MMBTU)			S20PCO (PPM)		S20NOX#M (LB/MMBTU)		S20STEAM (KLBS/HR)								
	Parameter	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTU/CF)	0.095	37.9	0.247	82	0.093	37.0	0.244	76	0.095	35.9	0.238	85	0.098	35.7	0.234	80
07/23/13 15:20	0.103	5.0	21.3	39.6	1,877.0																	
07/23/13 15:21	0.099	5.1	21.1	39.9	1,877.0																	
07/23/13 15:22	0.096	5.1	21.7	39.0	1,877.0																	
07/23/13 15:23	0.098	5.0	21.9	37.5	1,877.0																	
07/23/13 15:24	0.099	5.0	22.0	37.2	1,877.0																	
07/23/13 15:25	0.101	5.0	21.7	38.0	1,877.0																	
07/23/13 15:26	0.102	5.0	22.3	38.2	1,877.0																	
07/23/13 15:27	0.100	5.0	21.9	38.4	1,877.0																	
07/23/13 15:28	0.101	4.9	21.8	37.5	1,877.0																	
07/23/13 15:29	0.102	4.9	21.8	36.5	1,877.0																	
07/23/13 15:30	0.099	5.0	21.6	39.1	1,877.0																	
07/23/13 15:31	0.101	5.0	21.3	39.3	1,877.0																	
07/23/13 15:32	0.099	5.0	21.4	39.0	1,877.0																	
07/23/13 15:33	0.100	5.0	21.1	40.2	1,877.0																	
07/23/13 15:34	0.102	5.0	21.6	39.1	1,877.0																	
07/23/13 15:35	0.104	4.9	21.9	37.0	1,877.0																	
07/23/13 15:36	0.104	4.9	22.0	37.8	1,877.0																	
07/23/13 15:37	0.105	4.9	22.0	38.5	1,877.0																	
07/23/13 15:38	0.104	5.0	22.0	37.5	1,877.0																	
07/23/13 15:39	0.101	5.1	21.9	36.7	1,877.0																	
07/23/13 15:40	0.098	5.1	21.5	37.1	1,877.0																	
Average	0.101	5.0	21.7	38.2	1,877.0																	
Minimum	0.096	4.9	21.1	36.5	1,877.0																	
Maximum	0.105	5.1	22.3	40.2	1,877.0																	
Summation	2.118	104.9	455.8	803.1	39,417.0																	
Included Data Points	21	21	21	21	21																	
Total number of Data Points	21	21	21	21	21																	

Average
Minimum
Maximum
Summation
Included Data Points
Total number of Data Points

F = Unit Offline E = Exceedance S = Substituted
 M = Maintenance T = Out Of Control U = Startup
 Report Generated: 07/23/13 15:41 Report Version 3.1.1130

C = Calibration * = Suspect T = Shutdown

STACKVISION2|reporter

SD Class Beta
Run #3

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 15:50 Through 07/23/2013 16:10

Time Online Criteria: 1 minute(s)

Source	S20						S20SO2#M (LB/MMBTU)	S20PCO (PPM)	S20NOX#M (LB/MMBTU)	S20STEAM (KLBS/HR)
	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTU/CF)					
Parameter Unit()										
07/23/13 15:50	0.106	5.0	20.9	37.3	1,877.0	0.094	38.7	0.232	79	
07/23/13 15:51	0.101	5.1	21.1	38.3	1,877.0	0.093	37.9	0.234	85	
07/23/13 15:52	0.102	5.2	20.6	41.5	1,877.0	0.089	38.5	0.249	79	
07/23/13 15:53	0.106	5.1	21.3	42.0	1,877.0	0.094	39.6	0.257	79	
07/23/13 15:54	0.106	5.1	20.7	41.8	1,877.0	0.091	39.5	0.255	84	
07/23/13 15:55	0.102	5.1	20.5	42.6	1,877.0	0.090	38.0	0.260	81	
07/23/13 15:56	0.102	5.1	20.6	43.6	1,877.0	0.091	38.1	0.266	77	
07/23/13 15:57	0.103	5.0	20.3	44.9	1,877.0	0.091	38.1	0.280	82	
07/23/13 15:58	0.103	5.0	20.6	44.1	1,877.0	0.092	37.8	0.275	82	
07/23/13 15:59	0.106	5.0	20.8	43.9	1,877.0	0.093	38.7	0.274	78	
07/23/13 16:00	0.103	5.1	20.5	44.5	1,877.0	0.090	38.2	0.272	79	
07/23/13 16:01	0.102	5.0	20.8	42.2	1,877.0	0.093	37.4	0.263	85	
07/23/13 16:02	0.103	5.1	20.8	40.5	1,877.0	0.091	38.2	0.247	79	
07/23/13 16:03	0.102	5.1	20.7	40.2	1,877.0	0.091	38.3	0.246	78	
07/23/13 16:04	0.101	5.1	20.9	38.6	1,877.0	0.092	37.8	0.236	86	
07/23/13 16:05	0.103	5.1	20.8	38.9	1,877.0	0.091	38.3	0.238	78	
07/23/13 16:06	0.102	5.1	20.7	38.1	1,877.0	0.091	38.1	0.233	77	
07/23/13 16:07	0.103	5.1	21.2	38.8	1,877.0	0.093	38.4	0.237	86	
07/23/13 16:08	0.101	5.1	20.5	40.7	1,877.0	0.090	38.1	0.249	82	
07/23/13 16:09	0.096	5.2	20.5	40.7	1,877.0	0.088	36.2	0.244	78	
07/23/13 16:10	0.098	5.1	20.7	39.2	1,877.0	0.091	36.5	0.239	83	
Average	0.102	5.1	20.7	41.1	1,877.0	0.091	38.1	0.252	81	
Minimum	0.096	5.0	20.3	37.3	1,877.0	0.088	36.2	0.232	77	
Maximum	0.106	5.2	21.3	44.9	1,877.0	0.094	39.6	0.280	86	
Summation	2.151	106.8	435.5	862.4	39,417.0	1,919	800.4	5,286	1,697	
Included Data Points	21	21	21	21	21	21	21	21	21	
Total number of Data Points										

F = Unit Offline E = Exceedance T = Out Of Control C = Calibration S = Substituted I = Invalic
 M = Maintenance * = Suspect U = Startup D = Shutdown
 STACKV/SION2\reportuser

Report Generated: 07/23/13 16:11
 Report Version 3.1.1130

MPU01651
 1 of 1

S20 Gas Run #4

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 16:20 Through 07/23/2013 16:40

Time Online Criteria: 1 minute(s)

Source	S20						S20STEAM		
	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTUCF)	S20NOX#M (LB/MMBTU)	S20PCO (PPM)	S20SO2#M (LB/MMBTU)	S20STEAM (KLBS/HR)
Parameter Unit									
07/23/13 16:20	0.098	5.1	20.8	39.9	1,877.0	0.091	36.7	0.244	79
07/23/13 16:21	0.099	5.0	20.6	39.3	1,877.0	0.092	36.2	0.245	87
07/23/13 16:22	0.099	5.1	20.5	39.7	1,877.0	0.090	36.5	0.243	83
07/23/13 16:23	0.096	5.1	20.3	39.1	1,877.0	0.089	35.9	0.239	77
07/23/13 16:24	0.092	5.1	20.5	39.1	1,877.0	0.090	34.4	0.239	83
07/23/13 16:25	0.093	5.1	20.8	38.3	1,877.0	0.091	34.5	0.234	80
07/23/13 16:26	0.098	5.0	20.9	37.2	1,877.0	0.094	35.7	0.232	77
07/23/13 16:27	0.095	5.1	20.6	37.7	1,877.0	0.091	35.6	0.230	87
07/23/13 16:28	0.096	5.1	20.6	38.3	1,877.0	0.091	35.8	0.234	78
07/23/13 16:29	0.095	5.1	20.3	38.8	1,877.0	0.089	35.7	0.237	81
07/23/13 16:30	0.094	5.1	20.5	38.1	1,877.0	0.090	34.9	0.233	84
07/23/13 16:31	0.096	5.1	20.4	38.4	1,877.0	0.090	35.7	0.236	77
07/23/13 16:32	0.096	5.1	20.4	39.1	1,877.0	0.090	36.1	0.239	85
07/23/13 16:33	0.093	5.1	20.4	38.9	1,877.0	0.090	34.6	0.238	79
07/23/13 16:34	0.095	5.1	20.5	39.0	1,877.0	0.090	35.6	0.238	78
07/23/13 16:35	0.095	5.1	20.5	39.7	1,877.0	0.090	35.5	0.243	86
07/23/13 16:36	0.098	5.1	20.4	39.9	1,877.0	0.090	36.5	0.244	79
07/23/13 16:37	0.099	5.1	20.5	40.4	1,877.0	0.090	37.1	0.247	80
07/23/13 16:38	0.099	5.1	20.3	40.9	1,877.0	0.089	36.8	0.250	86
07/23/13 16:39	0.099	5.2	20.0	42.2	1,877.0	0.086	37.4	0.253	78
07/23/13 16:40	0.096	5.1	20.0	41.7	1,877.0	0.088	36.2	0.255	79
Average	0.096	5.1	20.5	39.3	1,877.0	0.090	35.9	0.241	81
Minimum	0.092	5.0	20.0	37.2	1,877.0	0.086	34.4	0.230	77
Maximum	0.099	5.2	20.9	42.2	1,877.0	0.094	37.4	0.255	87
Summation	2.021	107.0	429.8	825.7	39,417.0	1,891	753.4	5.052	1,703
Included Data Points	21	21	21	21	21	21	21	21	21
Total number of Data Points	21								

F = Unit Offline E = Exceedance C = Calibration S = Substituted
 M = Maintenance T = Out Of Control * = Suspect U = Startup
 Report Generated: 07/23/13 16:41 Report Version 3.1.1130 STACKVISON2reportuser

1 = invalid D = Shutdown
 MU01652

S20 Cross Rates

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 16:50 Through 07/23/2013 17:10

Time Online Criteria: 1 minute(s)

Source Parameter Unit	S20						S20SO2#M (LB/MMBTU)	S20PCO (PPM)	S20NOX#M (LB/MMBTU)	S20STEAM (KLBS/HR)
	S20CCFM (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTU/CF)	S20NOX#M (LB/MMBTU)				
07/23/13 16:50	0.094	5.1	20.5	38.7	1,877.0	0.090	34.9	0.236	80	80
07/23/13 16:51	0.094	5.1	20.3	39.2	1,877.0	0.089	35.3	0.239	80	80
07/23/13 16:52	0.095	5.1	20.4	38.6	1,877.0	0.090	35.7	0.236	85	85
07/23/13 16:53	0.095	5.1	21.1	38.1	1,877.0	0.093	35.4	0.233	78	78
07/23/13 16:54	0.097	5.0	20.6	38.9	1,877.0	0.092	35.9	0.242	79	79
07/23/13 16:55	0.095	5.1	20.4	40.3	1,877.0	0.090	35.4	0.246	85	85
07/23/13 16:56	0.095	5.1	20.2	40.2	1,877.0	0.089	35.5	0.246	75	75
07/23/13 16:57	0.099	5.1	20.7	40.8	1,877.0	0.091	36.7	0.249	86	86
07/23/13 16:58	0.096	5.1	19.8	42.1	1,877.0	0.087	36.3	0.257	80	80
07/23/13 16:59	0.094	5.1	20.3	42.2	1,877.0	0.089	35.2	0.258	78	78
07/23/13 17:00	0.097	5.1	20.3	41.6	1,877.0	0.089	36.4	0.254	86	86
07/23/13 17:01	0.101	5.1	20.4	40.3	1,877.0	0.090	37.6	0.246	82	82
07/23/13 17:02	0.099	5.1	20.0	39.5	1,877.0	0.088	36.8	0.241	76	76
07/23/13 17:03	0.095	5.1	19.8	39.1	1,877.0	0.087	35.5	0.239	86	86
07/23/13 17:04	0.097	5.1	20.2	39.9	1,877.0	0.089	36.3	0.244	77	77
07/23/13 17:05	0.101	5.0	20.3	39.3	1,877.0	0.091	37.4	0.245	82	82
07/23/13 17:06	0.100	5.1	19.9	40.5	1,877.0	0.087	37.0	0.247	85	85
07/23/13 17:07	0.097	5.1	20.0	41.2	1,877.0	0.088	36.1	0.252	78	78
07/23/13 17:08	0.100	5.1	20.0	40.8	1,877.0	0.088	37.4	0.249	79	79
07/23/13 17:09	0.100	5.1	20.0	42.2	1,877.0	0.088	37.4	0.258	84	84
07/23/13 17:10	0.102	5.1	20.3	41.3	1,877.0	0.089	37.8	0.252	82	82
Average	0.097	5.1	20.3	40.2	1,877.0	0.089	36.3	0.246	81	
Minimum	0.094	5.0	19.8	38.1	1,877.0	0.087	34.9	0.233	75	
Maximum	0.102	5.1	21.1	42.2	1,877.0	0.093	37.8	0.258	86	
Summation	2.043	106.9	425.5	844.8	39,417.0	1,874	762.0	5,169	1,703	
Included Data Points	21	21	21	21	21	21	21	21	21	
Total number of Data Points										

Average
Minimum
Maximum
Summation
Included Data Points
Total number of Data Points

F = Unit Offline E = Exceedance C = Calibration S = Substituted
 M = Maintenance T = Out Of Control * = Suspect U = Startup
 Report Generated: 07/23/13 17:10 Report Version 3.1.1130 STACKVISION2\reportuser

= Invited

D = Shutdown

Report Generated: 07/23/13 17:10

Report Version 3.1.1130

1 of 1

MPU01653

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 17:20 Through 07/23/2013 17:40

Time Online Criteria: 1 minute(s)

Source	S20						S20SO2#M (LB/MMBTU)			S20STEAM (KLBS/MMBTU)	
	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (#MMBTU/CF)	S20NOX#M (LB/MMBTU)	S20PCO (PPM)	S20SO2#M (LB/MMBTU)	S20STEAM (KLBS/MMBTU)	S20STEAM (KLBS/MMBTU)	
07/23/13 17:20	0.099	5.1	20.1	41.7	1,877.0	0.088	37.0	0.255	78	78	
07/23/13 17:21	0.098	5.2	19.7	41.1	1,877.0	0.085	37.1	0.246	84	84	
07/23/13 17:22	0.096	5.1	20.0	40.5	1,877.0	0.088	35.8	0.247	81	81	
07/23/13 17:23	0.099	5.1	20.5	39.6	1,877.0	0.090	36.9	0.242	77	77	
07/23/13 17:24	0.100	5.1	20.2	39.8	1,877.0	0.089	37.3	0.243	84	84	
07/23/13 17:25	0.099	5.1	20.2	39.6	1,877.0	0.089	37.2	0.242	82	82	
07/23/13 17:26	0.100	5.1	20.1	39.5	1,877.0	0.088	37.2	0.241	79	79	
07/23/13 17:27	0.098	5.2	19.9	41.6	1,877.0	0.086	37.2	0.249	85	85	
07/23/13 17:28	0.100	5.1	20.3	40.5	1,877.0	0.089	37.2	0.247	74	74	
07/23/13 17:29	0.099	5.1	20.4	40.4	1,877.0	0.090	37.1	0.247	84	84	
07/23/13 17:30	0.101	5.1	20.4	40.6	1,877.0	0.090	37.8	0.248	82	82	
07/23/13 17:31	0.100	5.1	20.3	39.1	1,877.0	0.089	37.6	0.239	76	76	
07/23/13 17:32	0.100	5.2	20.3	38.3	1,877.0	0.087	38.1	0.229	85	85	
07/23/13 17:33	0.099	5.2	20.7	37.8	1,877.0	0.089	37.8	0.226	78	78	
07/23/13 17:34	0.099	5.1	20.5	37.1	1,877.0	0.090	37.4	0.227	79	79	
07/23/13 17:35	0.098	5.2	20.4	37.8	1,877.0	0.088	37.3	0.226	87	87	
07/23/13 17:36	0.100	5.2	20.6	37.8	1,877.0	0.089	37.7	0.226	78	78	
07/23/13 17:37	0.102	5.2	20.3	38.5	1,877.0	0.087	38.6	0.231	78	78	
07/23/13 17:38	0.103	5.1	20.6	38.6	1,877.0	0.091	38.7	0.236	86	86	
07/23/13 17:39	0.103	5.1	20.2	39.4	1,877.0	0.089	39.0	0.241	78	78	
07/23/13 17:40	0.100	5.2	20.3	40.2	1,877.0	0.087	38.0	0.241	82	82	
Average	0.100	5.1	20.3	39.5	1,877.0	0.088	37.5	0.239	81	81	
Minimum	0.096	5.1	19.7	37.1	1,877.0	0.085	35.8	0.226	74	74	
Maximum	0.103	5.2	20.7	41.7	1,877.0	0.091	39.0	0.255	87	87	
Summation	2.093	107.9	426.0	829.5	39,417.0	1,858	788.0	5,029	1,697	1,697	
Included Data Points	21	21	21	21	21	21	21	21	21	21	
Total number of Data Points	21	21	21	21	21	21	21	21	21	21	

F = Unit Offline

M = Maintenance

T = Out Of Control

E = Exceedance

Report Generated: 07/23/13 17:43

C = Calibration

Report Version 3.1.1130

S = Substituted

Report Generated: 07/23/13 17:43

Run # 4

StackVISON2/reportuser

520 Gas Run #7

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 17:50 Through 07/23/2013 18:10

Time Online Criteria: 1 minute(s)

Source	S20						S20STEAM (KLBS/HR)		
	S20CO#M (#/MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTU/CF)	S20NOX#M (LB/MMMBTU)	S20FCO (PPM)	S20SO2#M (LB/MMMBTU)	
07/23/13 17:50	0.103	5.2	20.0	41.3	1,877.0	0.086	39.1	0.247	78
07/23/13 17:51	0.101	5.2	19.9	41.4	1,877.0	0.086	38.5	0.248	80
07/23/13 17:52	0.101	5.2	19.8	41.0	1,877.0	0.085	38.3	0.246	84
07/23/13 17:53	0.099	5.1	20.1	42.0	1,877.0	0.088	37.4	0.257	80
07/23/13 17:54	0.099	5.2	20.1	40.0	1,877.0	0.087	37.8	0.240	79
07/23/13 17:55	0.097	5.2	20.3	37.7	1,877.0	0.087	36.9	0.226	87
07/23/13 17:56	0.097	5.2	20.1	39.5	1,877.0	0.087	36.9	0.237	78
07/23/13 17:57	0.097	5.2	20.3	39.9	1,877.0	0.087	37.0	0.239	81
07/23/13 17:58	0.095	5.2	20.1	39.6	1,877.0	0.087	36.2	0.237	85
07/23/13 17:59	0.096	5.2	19.9	40.3	1,877.0	0.086	36.6	0.241	78
07/23/13 18:00	0.098	5.2	20.1	40.7	1,877.0	0.087	37.1	0.244	80
07/23/13 18:01	0.098	5.2	20.4	39.8	1,877.0	0.088	37.4	0.238	84
07/23/13 18:02	0.099	5.2	20.3	41.0	1,877.0	0.087	37.7	0.246	78
07/23/13 18:03	0.100	5.2	20.6	39.9	1,877.0	0.089	37.7	0.239	78
07/23/13 18:04	0.100	5.2	20.4	40.8	1,877.0	0.088	37.8	0.244	86
07/23/13 18:05	0.099	5.2	20.7	39.6	1,877.0	0.089	37.7	0.237	78
07/23/13 18:06	0.097	5.2	20.8	37.8	1,877.0	0.090	36.9	0.226	81
07/23/13 18:07	0.098	5.2	20.3	39.2	1,877.0	0.087	37.4	0.235	84
07/23/13 18:08	0.100	5.1	20.2	38.7	1,877.0	0.089	37.7	0.236	84
07/23/13 18:09	0.097	5.2	19.7	39.1	1,877.0	0.085	37.1	0.234	78
07/23/13 18:10	0.100	5.2	20.2	38.1	1,877.0	0.087	37.7	0.228	78
Average	0.099	5.2	20.2	39.9	1,877.0	0.087	37.5	0.239	81
Minimum	0.095	5.1	19.7	37.9	1,877.0	0.085	36.2	0.226	78
Maximum	0.103	5.2	20.8	42.0	1,877.0	0.090	39.1	0.257	87
Summation	2.071	109.0	424.3	837.4	39,417.0	1,832	786.9	5.025	1,699
Included Data Points	21	21	21	21	21	21	21	21	21
Total number of Data Points	21	21	21	21	21	21	21	21	21

520 Gas Rate
Run # 8

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 18:20 Through 07/23/2013 18:40

Time Online Criteria: 1 minute(s)

Source	S20						S20PCO (PPM)			S20NOX#M (LB/MMBTU)			S20PCO (PPM)			S20SO2#M (LB/MMBTU)			
	Parameter	Unit	S20CCPM (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20OFFACT (MMBTU/CF)												
07/23/13 18:20	0.094	5.2	20.4	41.0	1,877.0	0.088					35.5	0.246							80
07/23/13 18:21	0.095	5.2	20.5	40.6	1,877.0	0.088					36.3	0.243							78
07/23/13 18:22	0.093	5.2	20.3	41.0	1,877.0	0.087					35.6	0.246							86
07/23/13 18:23	0.093	5.2	20.2	41.3	1,877.0	0.087					35.6	0.247							76
07/23/13 18:24	0.096	5.2	20.2	40.2	1,877.0	0.087					36.2	0.241							82
07/23/13 18:25	0.096	5.2	20.5	41.2	1,877.0	0.088					36.4	0.247							84
07/23/13 18:26	0.095	5.2	20.0	44.5	1,877.0	0.086					36.3	0.267							77
07/23/13 18:27	0.097	5.2	20.4	43.3	1,877.0	0.088					36.7	0.259							81
07/23/13 18:28	0.098	5.1	20.8	42.3	1,877.0	0.091					37.4	0.258							84
07/23/13 18:29	0.102	5.1	20.7	39.7	1,877.0	0.091					38.3	0.243							75
07/23/13 18:30	0.099	5.1	20.5	38.6	1,877.0	0.090					37.0	0.236							85
07/23/13 18:31	0.098	5.2	20.8	39.3	1,877.0	0.090					37.2	0.235							80
07/23/13 18:32	0.097	5.2	20.2	40.4	1,877.0	0.087					36.9	0.242							78
07/23/13 18:33	0.094	5.2	20.1	39.4	1,877.0	0.087					36.0	0.236							86
07/23/13 18:34	0.095	5.2	20.5	37.7	1,877.0	0.088					36.1	0.226							77
07/23/13 18:35	0.093	5.2	20.3	39.1	1,877.0	0.087					35.4	0.234							79
07/23/13 18:36	0.093	5.2	20.7	39.9	1,877.0	0.089					35.6	0.239							86
07/23/13 18:37	0.096	5.2	20.3	39.5	1,877.0	0.087					36.2	0.237							78
07/23/13 18:38	0.096	5.2	20.4	40.4	1,877.0	0.088					36.7	0.242							78
07/23/13 18:39	0.095	5.2	20.8	39.0	1,877.0	0.090					36.0	0.234							85
07/23/13 18:40	0.096	5.2	20.7	38.7	1,877.0	0.089					36.5	0.232							78

Source

Parameter

Unit

Value

Average

0.096

5.2

20.4

40.3

1,877.0

0.088

36.4

0.242

81

Substitution

Minimum

0.093

20.0

37.7

0.086

35.4

0.226

75

Maximum

0.102

20.8

44.5

0.091

38.3

0.267

86

Summation

2.012

429.3

847.1

39,417.0

1,853

763.9

5,090

1,693

Included Data Points

21

21

21

21

21

21

21

21

21

21

21

Total number of Data Points

21

21

21

21

21

Points

Report Generated: 07/23/13 18:41

Report Version 3.1.1130

F = Unit Offline

M = Maintenance

T = Out Of Control

E = Exceedance

S = Substituted

U = Startup

V = Invalid

C = Calibration

* = Suspect

U = Shutdown

STACKVISION2 report user

MPU01656

1

of 1

S20 Gas DATA

Run #9

Average Data
 Plant: Manitowoc Public Utilities
 Interval: 1 Minute

Type: Roll with BAF Applied
 Report Period: 07/23/2013 18:50 Through 07/23/2013 19:10
 Time Online Criteria: 1 minute(s)

Source	S20						S20SO2#M (LB/MMBTU)	S20PCO (PPM)	S20NOX#M (LB/MMBTU)	S20STEAM (KLBS/Hr)
	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTUCF)					
07/23/13 18:50	0.091	5.2	20.7	40.7	1,877.0	0.089	34.8	0.244	85	
07/23/13 18:51	0.091	5.2	20.9	38.9	1,877.0	0.090	34.7	0.233	79	
07/23/13 18:52	0.093	5.2	21.2	40.9	1,877.0	0.091	35.2	0.245	78	
07/23/13 18:53	0.092	5.2	20.9	42.7	1,877.0	0.090	35.1	0.256	87	
07/23/13 18:54	0.093	5.2	20.7	46.3	1,877.0	0.089	35.3	0.277	77	
07/23/13 18:55	0.091	5.2	21.0	44.3	1,877.0	0.091	34.7	0.265	81	
07/23/13 18:56	0.092	5.2	20.9	42.0	1,877.0	0.090	35.0	0.252	87	
07/23/13 18:57	0.092	5.2	20.6	42.9	1,877.0	0.089	35.2	0.257	78	
07/23/13 18:58	0.092	5.2	21.1	43.6	1,877.0	0.091	35.0	0.261	77	
07/23/13 18:59	0.095	5.1	21.4	42.1	1,877.0	0.094	35.5	0.257	87	
07/23/13 19:00	0.095	5.2	20.9	41.4	1,877.0	0.090	36.0	0.248	78	
07/23/13 19:01	0.095	5.2	20.8	42.4	1,877.0	0.090	35.8	0.254	79	
07/23/13 19:02	0.097	5.1	20.4	43.4	1,877.0	0.090	36.4	0.265	85	
07/23/13 19:03	0.099	5.2	20.6	43.5	1,877.0	0.089	37.3	0.261	77	
07/23/13 19:04	0.096	5.2	20.8	41.7	1,877.0	0.090	36.4	0.250	84	
07/23/13 19:05	0.095	5.2	20.1	44.5	1,877.0	0.087	35.8	0.267	81	
07/23/13 19:06	0.094	5.1	20.9	41.6	1,877.0	0.092	35.2	0.254	77	
07/23/13 19:07	0.095	5.2	20.5	41.8	1,877.0	0.088	36.2	0.250	86	
07/23/13 19:08	0.095	5.2	20.8	41.3	1,877.0	0.090	36.2	0.247	75	
07/23/13 19:09	0.096	5.2	21.1	38.8	1,877.0	0.091	36.3	0.232	82	
07/23/13 19:10	0.097	5.2	20.8	41.0	1,877.0	0.090	36.9	0.246	83	
Average										
Minimum	0.094	5.2	20.8	42.2	1,877.0	0.090	35.7	0.253	81	
Maximum	0.091	5.1	20.1	38.8	1,877.0	0.087	34.7	0.232	75	
Summation	1.976	5.2	21.4	46.3	1,877.0	0.094	37.3	0.277	87	
Included Data Points	21	21	21	885.8	39,417.0	1,891	749.0	5,321	1,703	
Total number of Data Points	21	21	21	21	21	21	21	21	21	

F = Unit Offline
 M = Maintenance
 E = Exceedance
 T = Out Of Control
 S = Substituted
 * = Suspect
 C = Calibration
 U = Startup
 D = Shutdown
 STACKVISION2/reporter
 Report Generated: 07/23/13 19:11
 Report Version 3.1.1130

S20 Gas DATA
Run #10

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll with BAF Applied

Report Period: 07/23/2013 19:20 Through 07/23/2013 19:40
Time Online Criteria: 1 minute(s)

Source	S20						S20SO24M (LB/MMBTU)			S20STEAM (KLBS/HR)	
	Parameter	S20CO#M (#MMBTU)	S20CPCO2 (PERCENT)	S20CPNOX (PPM)	S20CPSO2 (PPM)	S20FFACT (MMBTU/CF)	S20NOX#M (LB/MMBTU)	S20PCO (PPM)	S20SO24M (LB/MMBTU)		
07/23/13 19:20	0.099	5.1	21.3	41.6	1,877.0	0.094	37.1	0.284		83	
07/23/13 19:21	0.098	5.2	20.9	43.3	1,877.0	0.090	37.1	0.259		81	
07/23/13 19:22	0.097	5.2	20.7	45.0	1,877.0	0.089	37.0	0.270		76	
07/23/13 19:23	0.096	5.2	21.1	42.0	1,877.0	0.091	36.6	0.252		86	
07/23/13 19:24	0.094	5.2	20.8	41.7	1,877.0	0.090	35.8	0.250		80	
07/23/13 19:25	0.097	5.1	20.7	42.7	1,877.0	0.091	36.5	0.261		78	
07/23/13 19:26	0.100	5.1	20.7	45.9	1,877.0	0.091	37.6	0.280		82	
07/23/13 19:27	0.099	5.2	20.9	43.8	1,877.0	0.090	37.5	0.262		85	
07/23/13 19:28	0.097	5.2	20.9	42.9	1,877.0	0.090	36.8	0.257		79	
07/23/13 19:29	0.095	5.2	20.5	45.9	1,877.0	0.088	36.3	0.275		77	
07/23/13 19:30	0.097	5.1	20.8	44.2	1,877.0	0.091	36.3	0.270		84	
07/23/13 19:31	0.097	5.1	21.0	41.7	1,877.0	0.092	36.2	0.255		78	
07/23/13 19:32	0.099	5.1	21.1	39.2	1,877.0	0.093	37.0	0.239		79	
07/23/13 19:33	0.096	5.2	20.8	39.5	1,877.0	0.090	36.3	0.237		85	
07/23/13 19:34	0.094	5.2	20.7	40.6	1,877.0	0.089	35.5	0.243		74	
07/23/13 19:35	0.094	5.2	20.7	39.6	1,877.0	0.089	35.6	0.237		82	
07/23/13 19:36	0.094	5.1	21.2	40.0	1,877.0	0.093	35.4	0.244		81	
07/23/13 19:37	0.095	5.3	21.1	40.7	1,877.0	0.089	36.8	0.239		78	
07/23/13 19:38	0.095	5.2	20.8	39.4	1,877.0	0.090	36.3	0.236		85	
07/23/13 19:39	0.099	5.2	20.9	41.4	1,877.0	0.090	37.6	0.248		79	
07/23/13 19:40	0.099	5.2	21.0	44.1	1,877.0	0.091	37.8	0.264		77	
Average	0.097	5.2	20.9	42.2	1,877.0	0.091	36.6	0.254		80	
Minimum	0.094	5.1	20.5	39.2	1,877.0	0.088	35.4	0.236		74	
Maximum	0.100	5.3	21.3	45.9	1,877.0	0.094	37.8	0.280		86	
Summation	2.031	108.6	438.6	885.2	39,417.0	1,901	769.1	5,332		1,689	
Included Data Points	21	21	21	21	21	21	21	21	21	21	
Total number of Data Points	21										

F = Unit Offline
M = Maintenance
T = Out Of Control
E = Exceedance
S = Substituted
* = Suspect
U = Startup
D = Shutdown
S = Calibration
= Invalid

S20 High Flow Rate
Run #1

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 10:40 Through 07/23/2013 10:46
Time Online Criteria: 1 minute(s)

Source	S20				
Parameter	S20CFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
Parameter)Unit(					S20STEMP (DEGFAHRE)
07/23/13 10:40	4,981,487.0	1,877.0	83.0	4,508	188
07/23/13 10:41	4,839,201.0	1,877.0	80.7	4,510	188
07/23/13 10:42	5,198,134.0	1,877.0	86.6	4,514	188
07/23/13 10:43	4,825,183.0	1,877.0	80.4	4,512	191
07/23/13 10:44	4,876,274.0	1,877.0	77.9	4,511	192
07/23/13 10:45	4,828,567.0	1,877.0	80.5	4,512	192
07/23/13 10:46	4,872,001.0	1,877.0	81.2	4,511	191
<hr/>					
Average	4,888,692.4	1,877.0	81.5	4,511	190
Minimum	4,676,274.0	1,877.0	77.9	4,508	188
Maximum	5,198,134.0	1,877.0	86.6	4,514	192
Summation	34,220,847.0	13,139.0	570.3	31,578	1,330
Included Data Points	7	7	7	7	7
Total number of Data Points	7	7	7	7	7

Report Generated: 07/23/13 11:13
Report Version 3.1.1130

F = Unit Offline E = Exceedance S = Substituted l = Invalid
 M = Maintenance T = Out Of Control U = Startup D = Shutdown
 C = Calibration * = Suspect STACKVISION2\reportuser

SAC High flow RATA

RW #2

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 10:47 Through 07/23/2013 10:53
Time Online Criteria: 1 minute(s)

Source	S20					
Parameter)Unit(	S20CPFLO (SCFH)	S20FACT (MMBTUCF)	S20FFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20STEMP (DEGFAHRE)
07/23/13 10:47	4,883,221.0	1,877.0	81.4	4.510	189	240.3
07/23/13 10:48	4,975,918.0	1,877.0	82.9	4.510	190	240.4
07/23/13 10:49	5,016,016.0	1,877.0	83.6	4.511	193	240.3
07/23/13 10:50	5,008,816.0	1,877.0	83.5	4.512	193	239.3
07/23/13 10:51	5,013,130.0	1,877.0	83.6	4.512	192	239.9
07/23/13 10:52	4,984,540.0	1,877.0	83.1	4.511	190	240.2
07/23/13 10:53	4,927,943.0	1,877.0	82.1	4.511	189	240.4
Average	4,972,797.7	1,877.0	82.9	4.511	191	240.1
Minimum	4,883,221.0	1,877.0	81.4	4.510	189	239.3
Maximum	5,016,016.0	1,877.0	83.6	4.512	193	240.4
Summation	34,809,584.0	13,139.0	580.2	31.577	1,336	1,660.8
Included Data Points	7	7	7	7	7	7
Total number of Data Points	7	7	7	7	7	7

F = Unit Offline E = Exceedance
 M = Maintenance T = Out Of Control
 Report Generated: 07/23/13 11:16 Report Version 3.1.1130

C = Calibration S = Substituted
 * = Suspect U = Startup
 STACKVISION2\reporteruser
 D = Shutdown

S20 High Flow Rate

Run # 3

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 10:54 Through 07/23/2013 11:00
Time Online Criteria: 1 minute(s)

Source	S20				
	S20CPFL0 (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
07/23/13 10:54	4,896,127.0	1,877.0	81.6	4.512	189
07/23/13 10:55	4,766,518.0	1,877.0	79.4	4.512	189
07/23/13 10:56	4,859,782.0	1,877.0	81.0	4.512	191
07/23/13 10:57	5,045,891.0	1,877.0	84.1	4.512	193
07/23/13 10:58	4,963,766.0	1,877.0	82.7	4.512	193
07/23/13 10:59	4,984,911.0	1,877.0	82.7	4.511	192
07/23/13 11:00	4,914,271.0	1,877.0	81.9	4.512	189
<hr/>					
Average	4,915,895.1	1,877.0	81.9	4.512	191
Minimum	4,766,518.0	1,877.0	79.4	4.511	189
Maximum	5,045,891.0	1,877.0	84.1	4.512	193
Summation	34,411,266.0	13,139.0	573.4	31,583	1,336
Included Data Points	7	7	7	7	7
Total number of Data Points	7	7	7	7	7

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 11:30 Through 07/23/2013 11:36
Time Online Criteria: 1 minute(s)

Source	S20				
	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
Parameter)Unit(
07/23/13 11:30	4,915,014.0	1,877.0	81.9	4,514	192
07/23/13 11:31	4,879,518.0	1,877.0	81.3	4,516	193
07/23/13 11:32	4,922,274.0	1,877.0	82.0	4,517	193
07/23/13 11:33	4,949,981.0	1,877.0	82.5	4,516	193
07/23/13 11:34	4,905,643.0	1,877.0	81.8	4,516	193
07/23/13 11:35	4,962,125.2	1,877.0	82.7	4,516	193
07/23/13 11:36	4,967,688.0	1,877.0	82.8	4,516	193
					236.4
					236.3
<hr/>					
Average	4,928,891.9	1,877.0	82.1	4,516	193
Minimum	4,879,518.0	1,877.0	81.3	4,514	192
Maximum	4,967,688.0	1,877.0	82.8	4,517	193
Summation	34,502,243.2	13,139.0	575.0	31,611	1,350
Included Data Points	7	7	7	7	7
Total number of Data Points	7	7	7	7	7

F = Unit Offline E = Exceedance
 M = Maintenance T = Out Of Control
 C = Calibration S = Substituted
 * = Suspect U = Startup
 D = Shutdown
 STACKVISION2reportuser
 Report Generated: 07/23/13 12:22
 Report Version 3.1.1130

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 11:37 Through 07/23/2013 11:43
Time Online Criteria: 1 minute(s)

Source	S20					S20STEAM (KLBS/HR)	S20TEMP (DEGFAHRE)
	S20CPFLOW (SCFM)	S20FACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)		
07/23/13 11:37	4,966,613.0	1,877.0	82.8	4,517	193	236.6	
07/23/13 11:38	4,978,343.0	1,877.0	83.0	4,517	193	236.7	
07/23/13 11:39	5,031,388.0	1,877.0	83.9	4,518	193	237.0	
07/23/13 11:40	5,007,867.0	1,877.0	83.5	4,518	193	237.2	
07/23/13 11:41	4,934,347.0	1,877.0	82.2	4,517	191	236.9	
07/23/13 11:42	4,876,063.0	1,877.0	81.3	4,516	190	236.7	
07/23/13 11:43	4,854,882.0	1,877.0	80.9	4,516	190	236.9	
<hr/>							
Average	4,949,929.0	1,877.0	82.5	4,517	192	236.9	
Minimum	4,854,882.0	1,877.0	80.9	4,516	190	236.6	
Maximum	5,031,388.0	1,877.0	83.9	4,518	193	237.2	
Summation	34,649,503.0	13,139.0	577.6	31,619	1,343	1,658.0	
Included Data Points	7	7	7	7	7	7	
Total number of Data Points	7	7	7	7	7	7	

F = Unit Offline E = Exceedance S = Substituted
 M = Maintenance T = Out Of Control U = Startup D = Shutdown
 * = Suspect Report Generated: 07/23/13 12:23 Report Version 3.1.1130
 STACKVISION2reporter

S20 High Flow
 Report
 Run #6

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 11:44 Through 07/23/2013 11:50

Time Online Criteria: 1 minute(s)

Source	S20				
	S20CPFL0 (SCFI)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
07/23/13 11:44	4,922,460.0	1,877.0	82.0	4.514	190
07/23/13 11:45	4,962,591.0	1,877.0	82.7	4.516	190
07/23/13 11:46	4,957,599.0	1,877.0	82.6	4.514	191
07/23/13 11:47	4,957,778.0	1,877.0	82.6	4.513	190
07/23/13 11:48	4,963,160.0	1,877.0	82.7	4.513	192
07/23/13 11:49	4,961,867.0	1,877.0	82.7	4.512	193
07/23/13 11:50	4,941,495.0	1,877.0	82.4	4.512	193
					237.2
					236.8
					236.7
Average	4,952,421.4	1,877.0	82.5	4.513	191
Minimum	4,922,460.0	1,877.0	82.0	4.512	190
Maximum	4,963,160.0	1,877.0	82.7	4.516	193
Summation	34,666,950.0	13,139.0	577.7	31.594	1,339
Included Data Points	7	7	7	7	7
Total number of Data Points	7	7	7	7	7

Average
 Minimum
 Maximum
 Summation
 Included Data Points
 Total number of Data Points

16

MPU01664

F = Unit Offline E = Exceedance C = Calibration S = Substituted
 M = Maintenance T = Out Of Control * = Suspect U = Startup D = Shutdown
 Report Generated: 07/23/13 12:26 Report Version 3.1.1130

STACKVISION2\reportuser

1 of 1

520 High Flow
Run #7

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll
Report Period: 07/23/2013 11:51 Through 07/23/2013 11:57
Time Online Criteria: 1 minute(s)

Source	S20					
	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20TEMP (DEGFAHRE)
Parameter Unit(07/23/13 11:51	4.976,607.0	1.877.0	82.9	4.511	193	237.0
07/23/13 11:52	4.969,779.0	1.877.0	82.8	4.511	190	237.3
07/23/13 11:53	4.976,104.0	1.877.0	82.9	4.514	186	237.4
07/23/13 11:54	5,007,856.0	1.877.0	83.5	4.515	187	237.6
07/23/13 11:55	4,868,911.0	1.877.0	81.1	4.514	192	237.7
07/23/13 11:56	4,831,348.0	1.877.0	80.5	4.514	191	237.7
07/23/13 11:57	4,914,628.0	1.877.0	81.9	4.515	188	237.3
 Included Data Points						
Total number of Data Points	7	7	7	7	7	7

Average	4,935,033.3	1.877.0	82.2	4.513	190	237.4
Minimum	4,831,348.0	1.877.0	80.5	4.511	186	237.0
Maximum	5,007,856.0	1.877.0	83.5	4.515	193	237.7
Summation	34,545,233.0	13,139.0	575.6	31,594	1,327	1,662.0

Included Data Points
Total number of Data Points

F = Unit Offline E = Exceedance
M = Maintenance T = Out Of Control
Report Generated: 07/23/13 12:28

C = Calibration S = Substituted
* = Suspect U = Startup
D = Shutdown
STACKVISION2\reporter

S20 High Temp
Run #8

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 11:58 Through 07/23/2013 12:04
Time Online Criteria: 1 minute(s)

Source	S20					S20TEMP (DEGFAHRE)
	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	
07/23/13 11:58	4,980,395.0	1,877.0	83.2	4,513	188	237.1
07/23/13 11:59	5,007,196.0	1,877.0	83.5	4,513	188	237.3
07/23/13 12:00	4,989,341.0	1,877.0	83.3	4,515	192	237.5
07/23/13 12:01	5,009,274.0	1,877.0	83.5	4,518	193	237.4
07/23/13 12:02	4,955,098.0	1,877.0	82.6	4,518	192	237.1
07/23/13 12:03	5,143,585.0	1,877.0	85.7	4,518	190	238.3
07/23/13 12:04	5,002,398.0	1,877.0	83.4	4,518	190	239.6
Average	5,015,326.7	1,877.0	83.6	4,516	190	237.8
Minimum	4,955,098.0	1,877.0	82.6	4,513	188	237.1
Maximum	5,143,585.0	1,877.0	85.7	4,518	193	239.6
Summation	35,107,287.0	13,139.0	585.2	31,613	1,333	1,664.3
Included Data Points	7	7	7	7	7	7
Total number of Data Points	7	7	7	7	7	7

F = Unit Offline E = Exceedance
 M = Maintenance T = Out Of Control
 Report Generated: 07/23/13 12:30

C = Calibration S = Substituted I = Invalid
 * = Suspect U = Startup D = Shutdown
 STACKVISON2reportuser
 Report Version 3.1.1130

Stack S20 H44
Flow R070
Run 89

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 12:05 Through 07/23/2013 12:11
Time Online Criteria: 1 minute(s)

Source	S20				
	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
07/23/13 12:05	4,860,606.0	1,877.0	81.0	4,518	190
07/23/13 12:06	4,864,886.0	1,877.0	81.1	4,519	190
07/23/13 12:07	4,920,948.0	1,877.0	82.0	4,519	191
07/23/13 12:08	4,986,024.0	1,877.0	83.3	4,517	193
07/23/13 12:09	4,995,476.0	1,877.0	83.3	4,517	194
07/23/13 12:10	4,963,266.0	1,877.0	82.7	4,517	194
07/23/13 12:11	4,966,353.0	1,877.0	82.8	4,516	191
					240.0
					240.1
					240.1
Average	4,938,219.9	1,877.0	82.3	4,518	192
Minimum	4,860,606.0	1,877.0	81.0	4,516	190
Maximum	4,996,024.0	1,877.0	83.3	4,519	194
Summation	34,567,539.0	13,139.0	576.2	31,623	1,343
Included Data Points	7	7	7	7	7
Total number of Data Points	7	7	7	7	7

F = Unit Offline E = Exceedance S = Substituted I = Invalid
 M = Maintenance T = Out Of Control * = Suspect U = Startup D = Shutdown
 Report Generated: 07/23/13 12:33 Report Version 3.1.1130

Stack S20 High
 Flow Rate
 Run #10

Average Data

Plant: Manitowoc Public Utilities
 Interval: 1 Minute

Type: Roll
 Report Period: 07/23/2013 12:12 Through 07/23/2013 12:18
 Time Online Criteria: 1 minute(s)

Source	S20				
Parameter Unit	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20FFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
07/23/13 12:12	4,975,304.0	1,877.0	82.9	4,515	190
07/23/13 12:13	4,929,126.0	1,877.0	82.2	4,514	190
07/23/13 12:14	4,870,029.0	1,877.0	81.2	4,513	190
07/23/13 12:15	5,192,558.0	1,877.0	86.5	4,514	190
07/23/13 12:16	5,170,573.0	1,877.0	86.2	4,517	190
07/23/13 12:17	5,140,660.0	1,877.0	85.7	4,517	191
07/23/13 12:18	4,988,190.0	1,877.0	83.1	4,516	194
<hr/>					
Average	5,038,062.9	1,877.0	84.0	4,515	191
Minimum	4,870,029.0	1,877.0	81.2	4,513	190
Maximum	5,192,558.0	1,877.0	86.5	4,517	194
Summation	35,266,440.0	13,139.0	587.8	31,606	1,335
Included Data Points	7	7	7	7	7
Total number of Data Points	7	7	7	7	7

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 05:15 Through 07/23/2013 05:25

Time Online Criteria: 1 minute(s)

Source	S20					
Parameter Unit	S20CPFL0 (SCFH)	S20FFACT (MMBTU/CF)	S20PFLW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20STEMP (DEGFAHRE)
07/23/13 05:15	3,567,357.0	1,805.0	59.5	4.478	81	212.9
07/23/13 05:16	3,658,121.0	1,805.0	61.0	4.477	87	212.5
07/23/13 05:17	3,535,780.0	1,805.0	58.9	4.476	80	212.4
07/23/13 05:18	3,205,500.0	1,805.0	53.4	4.476	80	210.8
07/23/13 05:19	3,682,354.0	1,805.0	61.4	4.476	81	210.9
07/23/13 05:20	3,534,185.0	1,805.0	58.9	4.476	85	213.0
07/23/13 05:21	3,591,395.0	1,805.0	59.9	4.477	82	212.9
07/23/13 05:22	3,588,990.0	1,805.0	59.8	4.479	78	213.2
07/23/13 05:23	3,620,309.0	1,805.0	60.3	4.479	83	213.2
07/23/13 05:24	3,629,153.0	1,805.0	60.5	4.479	84	212.8
07/23/13 05:25	3,542,893.0	1,805.0	59.0	4.478	79	212.5
 Average						
Minimum						
Maximum						
Summation						
Included Data Points	11	11	11	11	11	11
Total number of Data Points	11	11	11	11	11	11

S20100 flow RA74
Run #2

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 06:20 Through 07/23/2013 06:30
Time Online Criteria: 1 minute(s)

Source	S20					
	S20CPFFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20STEMP (DEGFAHRE)
07/23/13 06:20	3,427,450.0	1,877.0	57.1	4.479	80	213.4
07/23/13 06:21	3,499,572.0	1,877.0	58.3	4.481	78	213.5
07/23/13 06:22	3,527,678.0	1,877.0	58.8	4.480	84	213.4
07/23/13 06:23	3,599,930.0	1,877.0	60.0	4.480	78	213.6
07/23/13 06:24	3,623,501.0	1,877.0	60.4	4.479	77	213.8
07/23/13 06:25	3,494,626.0	1,877.0	58.2	4.479	86	213.9
07/23/13 06:26	3,817,565.0	1,877.0	63.6	4.479	78	212.7
07/23/13 06:27	3,632,565.0	1,877.0	60.5	4.479	80	213.2
07/23/13 06:28	3,569,742.0	1,877.0	59.5	4.478	83	214.0
07/23/13 06:29	3,584,589.0	1,877.0	59.7	4.477	76	213.7
07/23/13 06:30	3,600,408.0	1,877.0	60.0	4.476	86	214.0
 Included Data Points						
Total number of Data Points	11	11	11	11	11	11

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F = Unit Offline E = Exceedance
 M = Maintenance T = Out Of Control
 * = Suspect C = Calibration
 U = Startup S = Substituted
 Report Generated: 07/23/13 07:36 Report Version 3.1.1130
 Stackvision2reporter User D = Shutdown

MPU01670

Report Generated: 07/23/13 07:36

1 of 1

S20 Low Flow Data

Run #3

Plant: Manitowoc Public Utilities
 Interval: 1 Minute
 Type: Roll

Report Period: 07/23/2013 06:31 Through 07/23/2013 06:38
 Time Online Criteria: 1 minute(s)

Source	S20			
Parameter Unit	S20CPFFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)
07/23/13 06:31	3,326,333.0	1,877.0	55.4	4,476
07/23/13 06:32	3,376,033.0	1,877.0	56.3	4,475
07/23/13 06:33	3,477,580.0	1,877.0	58.0	4,474
07/23/13 06:34	3,509,985.0	1,877.0	58.5	4,474
07/23/13 06:35	3,547,834.5	1,877.0	59.1	4,478
07/23/13 06:36	3,596,106.0	1,877.0	59.9	4,478
07/23/13 06:37	3,580,338.0	1,877.0	59.7	4,478
07/23/13 06:38	3,549,560.0	1,877.0	59.2	4,478
Average	3,495,470.8	1,877.0	58.3	4,476
Minimum	3,326,333.0	1,877.0	55.4	4,474
Maximum	3,596,106.0	1,877.0	59.9	4,478
Summation	27,963,766.5	15,016.0	486.1	35,811
Included Data Points	8	8	8	8
Total number of Data Points	8	8	8	8

	S20STEAM (KLBS/HR)	S20STEMP (DEGFAHRE)
Average	80	213.5
Minimum	77	213.9
Maximum	85	214.1
Summation	78	213.9
Included Data Points	78	213.7
Total number of Data Points	84	213.8

F = Unit Offline E = Exceedance
 M = Maintenance T = Out Of Control
 Report Generated: 07/23/13 07:36
 Report Version 3.1.1130

C = Calibration S = Substituted
 * = Suspect U = Startup
 D = Shutdown
 STACKVISON2reporter

S20 Low flow Rate
Run # 4

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 06:39 Through 07/23/2013 06:46
Time Online Criteria: 1 minute(s)

Source Parameter	\$20				
	\$20CPFL0 (SCFH)	\$20FFACT (MMBTU/CF)	\$20PFLOW (KSCFM)	\$20PVAC (PSIA)	\$20STEAM (KLBS/HR)
07/23/13 06:39	3,517,348.0	1,877.0	58.6	4,477	75
07/23/13 06:40	3,496,358.0	1,877.0	58.3	4,477	85
07/23/13 06:41	3,523,691.0	1,877.0	58.7	4,477	78
07/23/13 06:42	3,676,140.0	1,877.0	61.3	4,476	79
07/23/13 06:43	4,065,787.0	1,877.0	67.8	4,476	86
07/23/13 06:44	3,663,305.0	1,877.0	61.1	4,476	77
07/23/13 06:45	3,582,551.0	1,877.0	59.7	4,476	81
07/23/13 06:46	3,598,766.0	1,877.0	60.0	4,475	84
					213.8
Average	3,640,494.5	1,877.0	60.7	4,476	81
Minimum	3,496,358.0	1,877.0	58.3	4,475	75
Maximum	4,065,787.0	1,877.0	67.8	4,477	86
Summation	28,123,956.0	15,016.0	485.5	35,810	1,712.1
Included Data Points	8	8	8	8	8
Total number of Data Points	8	8	8	8	8

C = Calibration
* = Suspect

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F = Unit Offline E = Exceedance C = Calibration S = Substituted
M = Maintenance T = Out Of Control * = Suspect U = Startup D = Shutdown
Report Generated: 07/23/13 07:38 Report Version 3.1.1130 STACKVISON2reporter

MPU01672

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 07:02 Through 07/23/2013 07:10

Time Online Criteria: 1 minute(s)

Source	S20				S20STEAM (KLBS/Hr)	S20STEMP (DEGFAHRE)
Parameter )\Unit(	S20CPFL0 (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)		
07/23/13 07:02	3,578,907.0	1,877.0	59.6	4.479	84	215.0
07/23/13 07:03	3,593,742.0	1,877.0	59.9	4.479	77	213.9
07/23/13 07:04	3,543,220.0	1,877.0	59.1	4.478	84	213.4
07/23/13 07:05	3,530,361.0	1,877.0	58.8	4.477	80	213.0
07/23/13 07:06	3,926,854.0	1,877.0	65.4	4.476	79	212.8
07/23/13 07:07	3,850,736.0	1,877.0	64.2	4.476	85	213.5
07/23/13 07:08	3,660,117.0	1,877.0	61.0	4.475	78	214.0
07/23/13 07:09	3,667,440.0	1,877.0	61.0	4.475	80	213.9
07/23/13 07:10	3,596,556.0	1,877.0	59.9	4.474	83	213.5
<hr/>						
Average	3,659,770.3	1,877.0	61.0	4.477	81	213.7
Minimum	3,530,361.0	1,877.0	58.8	4.474	77	212.8
Maximum	3,926,854.0	1,877.0	65.4	4.479	85	215.0
Summation	32,937,933.0	16,893.0	548.9	40,289	730	1,923.0
Included Data Points	9	9	9	9	9	9
Total number of Data Points	9	9	9	9	9	9

F = Unit Offline
M = Maintenance
T = Out Of Control

E = Exceedance
S = Suspect
C = Calibration
U = Startup

S = Substituted
T = Inventory
D = Shutdown
STACKVISION2/reportuser

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 07:11 Through 07/23/2013 07:16
Time Online Criteria: 1 minute(s)

Source	S20					
Parameter Parameter Unit)Unit(	S20CPFLOW (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20STEMP (DEGFAHRE)
07/23/13 07:11	3,535,540.0	1,877.0	58.9	4.475	76	213.6
07/23/13 07:12	3,541,644.0	1,877.0	59.0	4.476	85	214.6
07/23/13 07:13	3,626,534.0	1,877.0	60.4	4.477	82	215.6
07/23/13 07:14	3,458,983.0	1,877.0	57.6	4.476	78	215.3
07/23/13 07:15	3,436,757.0	1,877.0	57.3	4.477	84	214.4
07/23/13 07:16	3,609,686.0	1,877.0	60.2	4.476	81	216.2
Average	3,534,857.3	1,877.0	58.9	4.476	81	215.0
Minimum	3,436,757.0	1,877.0	57.3	4.475	76	213.6
Maximum	3,626,534.0	1,877.0	60.4	4.477	85	216.2
Summation	21,209,144.0	11,262.0	353.4	26.857	486	1,289.7
Included Data Points	6	6	6	6	6	6
Total number of Data Points	6	6	6	6	6	6

F = Unit Offline E = Exceedance C = Calibration S = Substituted
 M = Maintenance T = Out Of Control * = Suspect U = Startup D = Shutdown
 Report Generated: 07/23/13 07:31 Report Version 3.1.1130
 STACKVISION2(reportuser)

520 low flow Rate
Run #1
1 of 1

S20 flow Rate
Run # 7

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 07:17 Through 07/23/2013 07:24
Time Online Criteria: 1 minute(s)

Source	S20				S20STEAMP (DEGFAHRE)
	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	
07/23/13 07:17	3,682,537.0	1,877.0	61.4	4.475	75
07/23/13 07:18	3,757,601.0	1,877.0	62.6	4.474	86
07/23/13 07:19	4,038,377.0	1,877.0	67.3	4.474	77
07/23/13 07:20	3,705,636.0	1,877.0	61.8	4.474	80
07/23/13 07:21	3,622,303.0	1,877.0	60.4	4.474	83
07/23/13 07:22	3,675,891.0	1,877.0	61.3	4.474	76
07/23/13 07:23	3,692,754.0	1,877.0	61.5	4.474	83
07/23/13 07:24	3,656,963.0	1,877.0	60.9	4.473	80
 Averages					
Average	3,729,007.8	1,877.0	62.1	4.474	80
Minimum	3,622,303.0	1,877.0	60.4	4.473	75
Maximum	4,038,377.0	1,877.0	67.3	4.475	86
Summation	29,832,062.0	15,016.0	497.2	35.792	640
Included Data Points	8	8	8	8	8
Total number of Data Points	8	8	8	8	8

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F = Unit Offline E = Exceedance
 M = Maintenance T = Out Of Control
 Report Generated: 07/23/13 07:33 Report Version 3.1.1130

C = Calibration S = Substituted
 * = Suspect U = Startup
 D = Shutdown
 I = Invalid
 STACKVISION2reportUser

MPU01675

S20 Low flow Rate

Run # 8

Average Data

Plant: Manitowoc Public Utilities

Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 07:42 Through 07/23/2013 07:49
Time Online Criteria: 1 minute(s)

Source	S20				
	S20CPFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)
07/23/13 07:42	3,616,118.0	1,877.0	60.3	4.479	84
07/23/13 07:43	3,552,281.0	1,877.0	59.4	4.481	81
07/23/13 07:44	3,631,463.0	1,877.0	60.5	4.480	78
07/23/13 07:45	3,673,711.0	1,877.0	61.2	4.480	82
07/23/13 07:46	3,663,955.0	1,877.0	61.1	4.480	85
07/23/13 07:47	3,754,963.0	1,877.0	62.6	4.480	76
07/23/13 07:48	3,841,202.0	1,877.0	64.0	4.479	85
07/23/13 07:49	3,677,906.0	1,877.0	61.3	4.478	80
Average	3,677,699.9	1,877.0	61.3	4.480	81
Minimum	3,552,281.0	1,877.0	59.4	4.478	76
Maximum	3,841,202.0	1,877.0	64.0	4.481	85
Summation	29,421,599.0	15,016.0	490.4	35,837	651
Included Data Points	8	8	8	8	8
Total number of Data Points	8	8	8	8	8

S20 low flow Rate
Run # 9

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 07:50 Through 07/23/2013 07:57
Time Online Criteria: 1 minute(s)

Source	S20				
Parameter	S20PFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	
				S20STEAM (KLBS/HR)	
07/23/13 07:50	3,606,383.0	1,877.0	60.1	4,479	78
07/23/13 07:51	3,584,968.0	1,877.0	59.7	4,478	86
07/23/13 07:52	3,152,380.0	1,877.0	52.5	4,478	79
07/23/13 07:53	3,595,443.0	1,877.0	59.9	4,481	79
07/23/13 07:54	3,771,717.0	1,877.0	62.9	4,482	86
07/23/13 07:55	3,761,010.0	1,877.0	62.7	4,482	78
07/23/13 07:56	3,746,944.0	1,877.0	62.4	4,482	79
07/23/13 07:57	3,446,218.0	1,877.0	57.4	4,482	85

Source

Parameter	S20PFLO (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20TEMP (DEGFAHRE)
07/23/13 07:50	3,606,383.0	1,877.0	60.1	4,479	78	216.4
07/23/13 07:51	3,584,968.0	1,877.0	59.7	4,478	86	216.1
07/23/13 07:52	3,152,380.0	1,877.0	52.5	4,478	79	214.5
07/23/13 07:53	3,595,443.0	1,877.0	59.9	4,481	79	214.2
07/23/13 07:54	3,771,717.0	1,877.0	62.9	4,482	86	215.1
07/23/13 07:55	3,761,010.0	1,877.0	62.7	4,482	78	216.4
07/23/13 07:56	3,746,944.0	1,877.0	62.4	4,482	79	216.4
07/23/13 07:57	3,446,218.0	1,877.0	57.4	4,482	85	216.0

Average	3,583,131.6	1,877.0	59.7	4,481	215.6
Minimum	3,152,380.0	1,877.0	52.5	4,478	214.2
Maximum	3,771,717.0	1,877.0	62.9	4,482	216.4
Summation	28,665,053.0	15,016.0	477.6	35,844	1,725.1
Included Data Points	8	8	8	8	8
Total number of Data Points	8	8	8	8	8

F = Unit Offline E = Exceedance C = Calibration S = Substituted
 M = Maintenance T = Out Of Control * = Suspect U = Startup
 Report Generated: 07/23/13 08:09 Report Version 3.1.1130 STACKVISION2/reporter
 1 of 1

Average Data

Plant: Manitowoc Public Utilities
Interval: 1 Minute

Type: Roll

Report Period: 07/23/2013 07:58 Through 07/23/2013 08:06
Time Online Criteria: 1 minute(s)

Source	Parameter Unit(S20CPFIQ (SCFH)	S20FFACT (MMBTU/CF)	S20PFLOW (KSCFM)	S20PVAC (PSIA)	S20STEAM (KLBS/HR)	S20STEMP (DEGFAHRE)
07/23/13 07:58	3,524,282.0	1,877.0	58.7	4.481	78	216.2	
07/23/13 07:59	3,602,260.0	1,877.0	60.0	4.481	82	216.2	
07/23/13 08:00	3,680,786.0	1,877.0	61.3	4.481	80	216.2	
07/23/13 08:01	3,756,847.0	1,877.0	62.6	4.483	79	216.5	
07/23/13 08:02	3,732,757.0	1,877.0	62.2	4.483	85	216.1	
07/23/13 08:03	3,699,318.0	1,877.0	61.7	4.484	79	214.9	
07/23/13 08:04	3,783,668.0	1,877.0	63.1	4.485	81	214.4	
07/23/13 08:05	3,817,910.0	1,877.0	63.6	4.485	84	215.1	
07/23/13 08:06	3,700,794.0	1,877.0	61.7	4.485	76	216.5	
Average							
Minimum							
Maximum							
Summation							
Included Data Points	9	9	9	4.483	80	215.8	
Total number of Data Points	9	9	9	4.481	76	214.4	
				4.485	85	216.5	
				40.348	724	1,942.1	
				554.9			
				9	9		
				9	9		
				9	9		

30

F = Unit Offline E = Exceedance
M = Maintenance T = Out Of Control
Report Generated: 07/23/13 08:10 Report Version 3.1.1130

C = Calibration S = Substituted
* = Suspect U = Startup
D = Shutdown
STACKVISION2reportuser

MPU01678

RATA Test - Part 75

Plant: MPU Source: S20

Parameter: S20CPFLO
 Effective Date/Time: 07/23/2013 13:18
 Monitoring System ID: X03
 Test Reason: QA-Periodic Quality Assurance
 Overall RA: 4.28
 CEMS Time Offset :
 Test Comment:

Operating Level: Low	Level BAF: 1.000	APS Indicator: False	Report in EDR: Y
Mean CEMS: 3,629,444.444	Relative Accuracy: 3.12	tValue: 2.306	Use BAF: Y
Mean Reference: 3,663,444.444	Standard Deviation: 104,267.684	Avg Load: 81	Reference Method: 2
Mean Difference: 34,000.000	Confidence Coefficient: 80,147.093		
Flow/Load Ratio: 0.45	CO/O2 RM Used:	Stack Dia:	Default WAF:
Heat/Load Ratio: 967.3	Reference Heat:	Stack Area:	Calculated WAF:
Run	Started	Ended	CEMS Value
			Difference
1	07/23/2013 05:15	07/23/2013 05:25	3,560,000.0
2	07/23/2013 06:20	07/23/2013 06:30	3,580,000.0
3	07/23/2013 06:31	07/23/2013 06:38	3,723,000.0
4	07/23/2013 06:39	07/23/2013 06:46	3,537,000.0
5	07/23/2013 07:02	07/23/2013 07:10	3,711,000.0
6	07/23/2013 07:11	07/23/2013 07:16	3,679,000.0
7	07/23/2013 07:17	07/23/2013 07:24	3,706,000.0
8	07/23/2013 07:42	07/23/2013 07:49	3,600,000.0
9	07/23/2013 07:50	07/23/2013 07:57	3,622,000.0
10	07/23/2013 07:58	07/23/2013 08:06	3,653,000.0
Run	Started	Ended	Load
			Use
			82
			Y
			80
			Y
			80
			Y
			81
			Y
			81
			Y
			80
			Y
			81
			Y
			81
			Y
			80
			Y
			78,000.0
			-23,000.0
			144,000.0
			51,000.0
			3,535,000.0
			3,729,000.0
			3,660,000.0
			3,495,000.0
			3,640,000.0
			-103,000.0
			228,000.0
			140,000.0
			183,000.0
			3,580,000.0
			3,723,000.0
			3,537,000.0
			3,711,000.0
			3,679,000.0
			3,706,000.0
			3,600,000.0
			3,622,000.0
			3,653,000.0
			3,700,000.0

Operating Level: High	Relative Accuracy: 4.28	Level BAF: 1.000	APS Indicator: False	Report in EDR: Y
Mean CEMS: 4,953,666.667	tValue: 2.306			Use BAF: Y
Mean Reference: 4,786,666.667	Avg Load: 191			Reference Method: 2
Mean Difference: -167,000.000				
Flow/Load Ratio: 0.25				
Heat/Load Ratio: 8291				
CO/O2 RM Used:	Stack Dia:	Default WAF:		
Reference Heat:	Stack Area:	Calculated WAF:		

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 10:40	07/23/2013 10:46	4,724,000.0	4,889,000.0	-165,000.0	190	Y
2	07/23/2013 10:47	07/23/2013 10:53	4,760,000.0	4,973,000.0	-213,000.0	191	Y
3	07/23/2013 10:54	07/23/2013 11:00	4,775,000.0	4,916,000.0	-141,000.0	191	Y
4	07/23/2013 11:30	07/23/2013 11:36	4,714,000.0	4,929,000.0	-215,000.0	193	Y
5	07/23/2013 11:37	07/23/2013 11:43	4,819,000.0	4,950,000.0	-131,000.0	192	Y
6	07/23/2013 11:44	07/23/2013 11:50	4,696,000.0	4,952,000.0	-256,000.0	191	
7	07/23/2013 11:51	07/23/2013 11:57	4,815,000.0	4,935,000.0	-120,000.0	190	Y
8	07/23/2013 11:58	07/23/2013 12:04	4,857,000.0	5,015,000.0	-158,000.0	190	Y
9	07/23/2013 12:05	07/23/2013 12:11	4,830,000.0	4,938,000.0	-108,000.0	192	Y
10	07/23/2013 12:12	07/23/2013 12:18	4,786,000.0	5,038,000.0	-252,000.0	191	Y

Protocol Gas Details:

Gas Level Code	Gas Type Code	Vendor Identifier	Cylinder Identifier	Expiration Date
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Air Emissions Testing Data

QI Name:	AETB Name:
Exam Date:	AETB Phone Number:
Provider Name:	AETB Email:
Provider Email:	

RATA Test - Part 75

Plant: MPU Source: S20

Parameter: S20CPCO2	Unit of Measure: PERCENT
Effective Date/Time: 07/23/2013 20:40	Test Number: XML (X09-Q3-2013-001) / EDR (1)
Monitoring System ID: X09	Frequency: 4QTRS
Test Reason: QA-Periodic Quality Assurance	Test Result: Passed
Overall RA: 1.73	Overall BAF: 1.000
CEMS Time Offset:	
Test Comment:	

Operating Level: Low	Level BAF: 1.000	APS Indicator: False	Report in EDR: Y
Mean CEMS: 5.111	Relative Accuracy: 1.73	tValue: 2.306	Use BAF: Y
Mean Reference: 5.078	Standard Deviation: 0.071	Avg Load: 81	Reference Method: 3A
Mean Difference: -0.033	Confidence Coefficient: 0.054		

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 14:50	07/23/2013 15:10	4.9	5.0	-0.1	81	Y
2	07/23/2013 15:20	07/23/2013 15:40	4.9	5.0	-0.1	80	Y
3	07/23/2013 15:50	07/23/2013 16:10	5.0	5.1	-0.1	81	Y
4	07/23/2013 16:20	07/23/2013 16:40	5.1	5.1	0.0	81	Y
5	07/23/2013 16:50	07/23/2013 17:10	5.0	5.1	-0.1	81	Y
6	07/23/2013 17:20	07/23/2013 17:40	5.2	5.1	0.1	81	Y
7	07/23/2013 17:50	07/23/2013 18:10	5.2	5.2	0.0	81	Y
8	07/23/2013 18:20	07/23/2013 18:40	5.1	5.2	-0.1	81	Y
9	07/23/2013 18:50	07/23/2013 19:10	5.2	5.2	0.0	81	Y

RATA Test - Part 75

Plant: MPU Source: S20

Parameter: S20CPNOX
Effective Date/Time: 07/23/2013 20:40
Monitoring System ID: X06
Test Reason: QA-Periodic Quality Assurance
Overall RA: 3.08
CEMS Time Offset:
Test Comment:

Operating Level: Low
Mean CEMS: 20.780
Mean Reference: 20.240
Mean Difference: -0.540

Level BAF: 1.000
Relative Accuracy: 3.08
Standard Deviation: 0.117
Confidence Coefficient: 0.084

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 14:50	07/23/2013 15:10	21.7	22.0	-0.3	81	Y
2	07/23/2013 15:20	07/23/2013 15:40	21.2	21.7	-0.5	80	Y
3	07/23/2013 15:50	07/23/2013 16:10	20.2	20.7	-0.5	81	Y
4	07/23/2013 16:20	07/23/2013 16:40	19.9	20.5	-0.6	81	Y
5	07/23/2013 16:50	07/23/2013 17:10	19.6	20.3	-0.7	81	Y
6	07/23/2013 17:20	07/23/2013 17:40	19.6	20.3	-0.7	81	Y
7	07/23/2013 17:50	07/23/2013 18:10	19.6	20.2	-0.6	81	Y
8	07/23/2013 18:20	07/23/2013 18:40	19.9	20.4	-0.5	81	Y
9	07/23/2013 18:50	07/23/2013 19:10	20.3	20.8	-0.5	81	Y

RATA Test - Part 75

Plant: MPU Source: S20

Parameter: S20NOX#M
 Effective Date/Time: 07/23/2013 20:40
 Monitoring System ID: X05
 Test Reason: QA-Periodic Quality Assurance
 Overall RA: 2.61
 CEMS Time Offset :
 Test Comment:

Operating Level: Low						Level BAF: 1.000						APS Indicator: False						Report in EDR: Y					
Mean CEMS: 0.091						Relative Accuracy: 2.61						tValue: 2.306						Use BAF: Y					
Mean Reference: 0.090						Standard Deviation: 0.002						Avg Load: 81						Reference Method: 7E,3A					
Mean Difference: -0.001						Confidence Coefficient: 0.001						Difference						Load					
																		Use					
1	07/23/2013 14:50	07/23/2013 15:10	0.100	0.098	0.098	0.097	0.097	0.091	0.090	0.088	0.088	0.089	0.089	0.088	0.087	0.087	0.085	0.085	0.085	0.087	0.088	0.089	
2	07/23/2013 15:20	07/23/2013 15:40	0.098	0.098	0.098	0.097	0.097	0.091	0.090	0.088	0.088	0.089	0.089	0.088	0.087	0.087	0.085	0.085	0.085	0.087	0.088	0.089	
3	07/23/2013 15:50	07/23/2013 16:10	0.090	0.090	0.090	0.091	0.091	0.091	0.090	0.088	0.088	0.089	0.089	0.088	0.087	0.087	0.085	0.085	0.085	0.087	0.088	0.089	
4	07/23/2013 16:20	07/23/2013 16:40	0.088	0.088	0.088	0.090	0.090	0.090	0.089	0.088	0.088	0.089	0.089	0.088	0.087	0.087	0.085	0.085	0.085	0.087	0.088	0.089	
5	07/23/2013 16:50	07/23/2013 17:10	0.087	0.087	0.087	0.089	0.089	0.089	0.088	0.088	0.088	0.089	0.089	0.088	0.087	0.087	0.085	0.085	0.085	0.087	0.088	0.089	
6	07/23/2013 17:20	07/23/2013 17:40	0.085	0.085	0.085	0.086	0.086	0.086	0.085	0.085	0.085	0.086	0.086	0.085	0.084	0.084	0.082	0.082	0.082	0.084	0.085	0.086	
7	07/23/2013 17:50	07/23/2013 18:10	0.085	0.085	0.085	0.086	0.086	0.086	0.085	0.085	0.085	0.086	0.086	0.085	0.084	0.084	0.082	0.082	0.082	0.084	0.085	0.086	
8	07/23/2013 18:20	07/23/2013 18:40	0.087	0.087	0.087	0.088	0.088	0.088	0.087	0.087	0.087	0.088	0.088	0.087	0.086	0.086	0.084	0.084	0.084	0.086	0.087	0.088	
9	07/23/2013 18:50	07/23/2013 19:10	0.088	0.088	0.088	0.089	0.089	0.089	0.088	0.088	0.088	0.089	0.089	0.088	0.087	0.087	0.085	0.085	0.085	0.087	0.088	0.089	

RATA Test - Permit
Plant: MPU Source: S20

Parameter: S20PCO

Effective Date/Time: 07/23/2013 20:40

Test Result: Passed

Overall RA: 2.23

CEMS Time Offset :

Test Comment:

Operating Level: Low
Mean CEMS: 36.878
Mean Reference: 37.033
Mean Difference: 0.156
Confidence Coefficient: 0.671
Relative Accuracy: 2.23
Standard Deviation: 0.873
APS Indicator: False
tValue: 2.306
Avg Load: 81

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 14:50	07/23/2013 15:10	38.7	39.1	-0.4	81	Y
2	07/23/2013 15:20	07/23/2013 15:40	38.0	36.9	1.1	80	Y
3	07/23/2013 15:50	07/23/2013 16:10	40.5	38.1	2.4	81	
4	07/23/2013 16:20	07/23/2013 16:40	37.8	35.9	1.9	81	Y
5	07/23/2013 16:50	07/23/2013 17:10	36.1	36.3	-0.2	81	Y
6	07/23/2013 17:20	07/23/2013 17:40	36.4	37.5	-1.1	81	Y
7	07/23/2013 17:50	07/23/2013 18:10	37.3	37.5	-0.2	81	Y
8	07/23/2013 18:20	07/23/2013 18:40	36.4	36.4	0.0	81	Y
9	07/23/2013 18:50	07/23/2013 19:10	35.8	35.7	0.1	81	Y
10	07/23/2013 19:20	07/23/2013 19:40	36.8	36.6	0.2	80	

Air Emissions Testing Data

QI Name:
Exam Date:
Provider Name:
Provider Email:
AETB Name:
AETB Phone Number:
AETB Email:

RATA Test - Permit
 Plant: MPU Source: S20

Parameter: S20CO#M

Effective Date/Time: 07/23/2013 20:40

Test Result: Passed

Overall RA: 3.53

CEMS Time Offset :

Test Comment:

Operating Level: Low

Mean CEMS: 0.098

Mean Reference: 0.100

Mean Difference: 0.001

Relative Accuracy: 3.53
 Standard Deviation: 0.003
 Confidence Coefficient: 0.002

APS Indicator: False
 tValue: 2.306
 Avg Load: 81

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 14:50	07/23/2013 15:10	0.108	0.106	0.002	81	Y
2	07/23/2013 15:20	07/23/2013 15:40	0.107	0.101	0.006	80	Y
3	07/23/2013 15:50	07/23/2013 16:10	0.110	0.102	0.008	81	
4	07/23/2013 16:20	07/23/2013 16:40	0.101	0.096	0.005	81	Y
5	07/23/2013 16:50	07/23/2013 17:10	0.098	0.097	0.001	81	Y
6	07/23/2013 17:20	07/23/2013 17:40	0.096	0.100	-0.004	81	Y
7	07/23/2013 17:50	07/23/2013 18:10	0.098	0.099	-0.001	81	Y
8	07/23/2013 18:20	07/23/2013 18:40	0.097	0.096	0.001	81	Y
9	07/23/2013 18:50	07/23/2013 19:10	0.095	0.094	0.001	81	Y
10	07/23/2013 19:20	07/23/2013 19:40	0.097	0.097	0.000	80	Y

Air Emissions Testing Data

QI Name: _____ AETB Name: _____
 Exam Date: _____ AETB Phone Number: _____
 Provider Name: _____ AETB Email: _____
 Provider Email: _____

RATA Test - Part 75

Plant: MPU Source: S20

Parameter: S20CPSO2

Effective Date/Time: 07/23/2013 20:40

Monitoring System ID: X01

Test Reason: QA-Periodic Quality Assurance

Overall RA: 5.11

CEMS Time Offset :

Test Comment:

Unit of Measure: PPM
 Test Number: XML (X01-Q3-2013-001) / EDR (1)
 Frequency: 4QTRS
 Test Result: Passed
 Overall BAF: 1.032

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 14:50	07/23/2013 15:10	43.7	42.2	1.5	81	Y
2	07/23/2013 15:20	07/23/2013 15:40	42.2	38.2	4.0	80	
3	07/23/2013 15:50	07/23/2013 16:10	44.1	41.1	3.0	81	Y
4	07/23/2013 16:20	07/23/2013 16:40	40.8	39.3	1.5	81	Y
5	07/23/2013 16:50	07/23/2013 17:10	40.2	40.2	0.0	81	Y
6	07/23/2013 17:20	07/23/2013 17:40	40.6	39.5	1.1	81	Y
7	07/23/2013 17:50	07/23/2013 18:10	42.4	39.9	2.5	81	Y
8	07/23/2013 18:20	07/23/2013 18:40	42.3	40.3	2.0	81	Y
9	07/23/2013 18:50	07/23/2013 19:10	42.3	42.2	0.1	81	Y

RATA Test - Permit

Plant: MPU Source: S20

Parameter: S20SO2#M

Effective Date/Time: 07/23/2013 20:40

Test Result: Passed

Overall RA: 6.39

CEMS Time Offset :

Test Comment:

Operating Level: Low
Mean CEMS: 0.248
Mean Reference: 0.258
Mean Difference: 0.010

Relative Accuracy: 6.39
Standard Deviation: 0.008
Confidence Coefficient: 0.006

Run	Started	Ended	Reference Value	CEMS Value	Difference	Load	Use
1	07/23/2013 14:50	07/23/2013 15:10	0.280	0.262	0.018	81	Y
2	07/23/2013 15:20	07/23/2013 15:40	0.270	0.239	0.031	80	
3	07/23/2013 15:50	07/23/2013 16:10	0.274	0.252	0.022	81	Y
4	07/23/2013 16:20	07/23/2013 16:40	0.249	0.240	0.009	81	Y
5	07/23/2013 16:50	07/23/2013 17:10	0.249	0.246	0.003	81	Y
6	07/23/2013 17:20	07/23/2013 17:40	0.244	0.240	0.004	81	Y
7	07/23/2013 17:50	07/23/2013 18:10	0.256	0.239	0.017	81	Y
8	07/23/2013 18:20	07/23/2013 18:40	0.258	0.242	0.016	81	Y
9	07/23/2013 18:50	07/23/2013 19:10	0.256	0.253	0.003	81	Y
10	07/23/2013 19:20	07/23/2013 19:40	0.254	0.254	0.000	80	Y

Air Emissions Testing Data

QI Name: _____ AETB Name: _____
Exam Date: _____ AETB Phone Number: _____
Provider Name: _____ AETB Email: _____
Provider Email: _____

APPENDIX I

PROCEDURES

Please Note: In an effort to conserve paper, the procedure section of the appendix has been reserved for explanations of EPA methodology deviations. Please refer to the specific EPA Methods on the following EPA website:

<http://www.epa.gov/ttn/emc/>

APPENDIX J

CALCULATION EQUATIONS

LB/mmBtu	
Calculator	
SO2 : Calculator	
SO2 ppm,w =	43.7 19-7
CO2 %,w =	4.9
F-factor (Fc) =	1877
lb/million Btu =	0.278014192
	<i>SO2 : Equations</i>
	Using the wet SO2 and CO2 numbers, $F_c * 0.00000002595 * 64 * 100 * SO_2 \text{ ppm (wet)} / CO_2 \% \text{ (wet)}$
NOx : Calculator	
NOx ppm,w =	21.7 19-7
CO2 %,w =	4.9
F-factor (Fc) =	1877
lb/million Btu =	0.09922546
	<i>NOx : Equations</i>
	Using wet NOx and CO2 numbers: $F_c * 0.00000002595 * 46 * 100 * NO_x \text{ ppm (wet)} / CO_2 \% \text{ (wet)}$

$$S_d = \sqrt{\frac{\sum_{i=1}^n d_i^2 - \left[\sum_{i=1}^n d_i \right]^2 / n}{n-1}} \quad Eq. 2.4$$

12.4 Confidence Coefficient. Calculate the 2.5 percent error confidence coefficient (one-tailed), CC, as follows:

$$CC = t_{0.975} \frac{S_d}{\sqrt{n}} \quad Eq. 2.5$$

Where:

$t_{0.975}$ =t-value (see Table 2-1).

12.5 Relative Accuracy. Calculate the RA of a set of data as follows:

$$RA = \frac{|\bar{d}| + |CC|}{RM} \times 100 \quad Eq. 2.6$$

Where:

$|\bar{d}|$ =Absolute value of the mean differences (from Equation 2-3).

$|CC|$ =Absolute value of the confidence coefficient (from Equation 2-3).

RM=Average RM value. In cases where the average emissions for the test are less than 50 percent of the applicable standard, substitute the emission standard value in the denominator of Eq. 2-6 in place of RM. In all other cases, use RM.

13.0 Method Performance

13.1 Calibration Drift Performance Specification. The CEMS calibration must not drift or deviate from the reference value of the gas cylinder, gas cell, or optical filter by more than 2.5 percent of the span value. If the CEMS includes pollutant and diluent monitors, the CD must be determined separately for each in terms of concentrations (See Performance Specification 3 for the diluent specifications), and none of the CDs may exceed the specification.

13.2 Relative Accuracy Performance Specification. The RA of the CEMS must be no greater than 20 percent when RM is used in the denominator of Eq. 2-6 (average emissions during test are greater than 50 percent of the emission standard) or 10 percent when the applicable emission standard is used in the denominator of Eq. 2-6 (average emissions during test are less than 50 percent of the emission standard). For SO₂ emission standards of 130 to and including 86 ng/J (0.30 and 0.20 lb/million Btu), inclusive, use 15 percent of the applicable standard; below 86 ng/J (0.20 lb/million Btu), use 20 percent of the emission standard.

APPENDIX K

AETB REQUIREMENTS



Interpoll Laboratories, Inc.
4500 Ball Road NE
Circle Pines, MN 55014-1819
Tel: 763-786-6020
Fax: 763-786-7854
www.interpoll-labs.com

August 19, 2013

Manitowoc Public Utilities
Thomas E. Reed
1303 South 8th Street
P.O. Box 1090
Manitowoc, WI 54221-1090

Re: Part 75 Air Emission Testing Body Requirements

Mr. Reed

This letter addresses the requirements of 40 CFR Part 75. Specifically; effective March 27, 2012, 40 CFR Part 75 test programs must be conducted by an Air Emissions Testing Body (AETB) in accordance with the requirements set forth in ASTM D 7036-04, Standard Practice for Competent Air Emission Testing Body.

Consistent with Section 6.2.1(c), Appendix A, 40 CFR Part 75, the AETB shall provide to each customer a certification that the AETB operates in conformance with, and that data has been collected in accordance with, the requirements of ASTM D 7036-04.

This letter serves as certification that Interpoll Laboratories, Inc. does provide data and services which comply with the above requirements.

Regards,

A handwritten signature in black ink, appearing to read "Daniel Despen".

Daniel Despen
President
Interpoll Laboratories, Inc.

Stack Vision Entry Requirements**Required AETB Data Per Part 75**

Field	Entry	Description
Q1 Last Name	Aaron	Required-Qualified Individual's last name
Q1 First Name	Wilson	Required-Qualified Individual's first name
Q1 Middle Initial	M.	Required-Qualified Individual's middle initial
AETB Name	Interpoll Laboratories, Inc.	Required-The AETB company whom the Qualified Individual represents.
AETB Phone Number	763-786-6020	Required-AETB company phone number.
AETB Email	stack@interpoll-labs.com	Required-AETB company email address or the email address of the qualified individual.
Exam Date	1/13/2012	Required-Date the Qualified Individual completed the AETB exam that certifies this person to conduct RATA tests.
Exam Provider Name	Source Evaluation Society	Required-Name of the agency who provided the exam
Exam Provider Email	ostiprogram@gmail.com	Required-Email address for the agency who provided the exam.
Comment		Optional field for additional comments.

Note-Interpoll Laboratories will be providing a letter of certification signed by a member of the senior management staff of the AETB for the clients records.